

ZR28-0616-0  
Course 77479



**National Service Division  
Service Education  
Student Guide**

**IBM PC Convertible**

# Preface

This publication is primarily intended for use by service personnel enrolled in course 77479.

## First Edition (March 1986)

References in this publication to IBM products, programs, or services do not imply that IBM intends to make these available in all countries in which IBM operates. Any reference to an IBM program product in this publication is not intended to state or imply that only IBM's program product may be used. Any functionally equivalent program may be used instead.

Publications are not stocked at the address given below. Requests for IBM publications should be made to your IBM representative or to the IBM branch office serving your locality.

Address comments concerning the content of this publication to IBM Corporation, NSD Service Education, Course Development, Department 70C/808, 11400 Burnet Road, Austin, TX U S A 78758. IBM may use or distribute whatever information you supply in any way it believes appropriate without incurring any obligation to you.

# Safety

*This product meets IBM safety standards*

The following information has been included in this publication for the use and safety of IBM personnel. For more information, see

- *Electrical Safety for IBM Service Representatives*, S229-8124
- *Safety/Health Guidelines for IBM Service Representatives*, S241-5493

## General Safety during Work

Use these rules to ensure general safety

- Observe good housekeeping in the area of the machines during maintenance and after completing it
- Use only field-supply items (such as adhesives, cleaning fluids, lubricants, paints, and solvents) that have been approved by IBM, that is, are supplied under an IBM part number
- When lifting any heavy object
  - 1 Ensure that you can stand safely without slipping
  - 2 Balance the weight of the object between your two feet
  - 3 Use a slow lifting force. Never move suddenly or twist when you attempt to lift.
  - 4 Lift by standing or by pushing up with your leg muscles, this action removes the strain from the muscles in your back. *Do not attempt to lift any objects that you think are too heavy for you*
- Do not perform any action that causes hazards to the customer or that makes the equipment unsafe
- Put removed covers and other parts in a safe place, away from all personnel, while you are servicing the machine
- Always keep your tool case away from walk areas so that other persons will not trip over it, for example, put it under a desk or table.
- Do not wear loose clothing that can be trapped in the moving parts of a machine. Ensure that your sleeves are fastened or are rolled up above the elbows. If your hair is long, fasten it
- Do not wear jewelry, chains, metal-frame eyeglasses, or metal fasteners for your clothing

*Remember* A metal object lets more current flow if you touch a live conductor

- Insert the ends of your necktie or scarf inside other clothing or fasten the necktie with a clip, preferably nonconductive, approximately 8 centimeters (3 inches) from the ends
- Wear safety glasses when you are
  - Using a hammer to drive pins or similar parts
  - Drilling with a power hand-drill
  - Using spring hooks or attaching springs
  - Soldering parts
  - Cutting wire or removing steel bands

- Cleaning parts with solvents, chemicals, or cleaning fluids
- Working in any other conditions that might be hazardous to your eyes
- Before you start the machine, ensure that other service representatives and the customer's personnel are not in a hazardous position
- After maintenance, reinstall all safety devices such as shields, guards, labels, and ground wires. Exchange any safety device that is worn or defective for a new one.

*Remember:* Safety devices protect personnel from hazards. You destroy the purpose of the devices if you do not reinstall them before completing your service call.

- Reinstall all covers correctly before returning the machine to the customer.

## Safety with Electricity

Observe these additional rules when working on equipment powered by electricity.

- Find the room emergency power-off (EPO) switch or disconnecting switch. If an electrical accident occurs, you can then operate the switch quickly.
- Do not work alone under hazardous conditions or near equipment that has hazardous voltages. Always inform your manager of any possible problem or if you must work alone.
- Disconnect all power.
  - Before removing or installing main units
  - Before working near power supplies
  - Before doing a mechanical inspection of power supplies
  - Before installing changes in machine circuits
- Before you start to work on the machine, unplug the machine's power cable. If you cannot unplug the cable easily, ask the customer to switch off the wall box switch that supplies power to the machine, and either
  - Lock the wall box switch in the off position, or
  - Attach a DO NOT OPERATE tag, Z229-0237, to the wall box switch.

*Note:* A non-IBM attachment to an IBM machine can be powered possibly from another source and controlled by a different disconnecting switch or circuit breaker. If you determine that this condition is present, ensure that you remove (eliminate) this hazard before you start work.

- If you need to work on a machine that has *exposed* electrical circuits, observe the following precautions:
  - Ensure that another person, who is familiar with the power-off controls, is near you.

*Remember:* Another person must be there to switch off the power, if necessary.

- **CAUTION**  
Some IBM hand tools have handles covered with a soft material that does not insulate you when working with live electrical circuits.

Use only those tools and testers that are suitable for the job you are doing

- Use only one hand when working with powered-on electrical equipment, keep the other hand in your pocket or behind your back

*Remember* There must be a complete circuit to cause electrical shock. By observing the above rule, you may prevent a current from passing through the vital parts of your body

- When using testers, set the controls correctly and use the IBM-approved probe leads and accessories intended for that tester

- **CAUTION**

Many customers have, near their equipment, rubber floor mats that contain small conductive fibers to decrease electrostatic discharges. Do not use this wrong type of mat to protect yourself from electric shock.

Stand on suitable rubber mats (obtained locally, if necessary) to insulate you from grounds such as metal floor strips and machine frames

- Observe the special safety precautions when you work with very high voltages, these instructions are given in IBM safety service memorandums (SMs) and the safety sections of maintenance information. Use extreme care when measuring high voltages
- Do not use tools or testers that have not been approved by IBM. Ensure that electrical hand tools, such as power drills and Wire-Wrap<sup>1</sup> tools, are inspected regularly
- Do not use worn or broken tools and testers
- *Never assume* that power has been disconnected from a circuit. First, *check* that it has been switched off
- Always look carefully for possible hazards in your work area. Examples of these hazards are moist floors, non-grounded power extension cables, power surges, and missing safety grounds.
- Do not touch live electrical circuits with the glass surface of a plastic dental mirror. The surface is conductive, such touching can cause personal injury and machine damage
- Unless the maintenance information specifically lets you, do not service the following parts *with power on them* when they are removed from their normal operating places in a machine.

Power supply units  
Pumps  
Blowers and fans

---

<sup>1</sup> Trademark of the Gardner-Denver Co

Motor generators

and similar units (This rule ensures correct grounding of the units )

- If an electrical accident occurs
  - Use caution; do not become a victim yourself.
  - Switch off power.
  - Send another person to get medical aid.
  - If the victim is not breathing, decide whether to give rescue breathing.

These actions are described below


## Emergency First Aid

When giving rescue breathing after an electrical accident

- *Use Caution* If the victim is still in contact with the electrical-current source, remove the power, to do this, you may need to use the room emergency power-off (EPO) switch or disconnecting switch  
  
If you cannot find the switch, use a dry wooden rod or some other nonconductive object to pull or push the victim away from contact with the electrical-current source
- *Work Quickly* If the victim is unconscious, he or she possibly needs rescue breathing. If the heart has stopped beating, the victim may also need external cardiac compression.  
  
**Only a trained and certified person<sup>2</sup> should perform external cardiac compressions.**
- *Get Medical Aid* Call a rescue group, an ambulance, or a hospital immediately

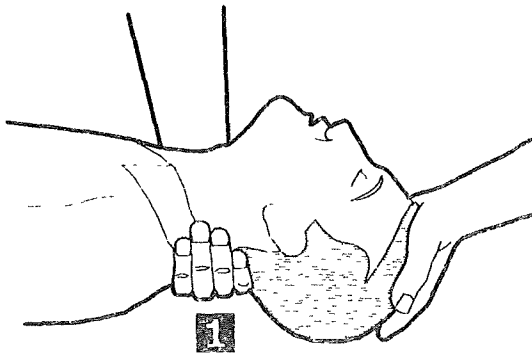
## Rescue Breathing Procedures

Determine if the victim needs rescue breathing:

- 1 Prepare the victim
  - a Ensure that the victim's airway is open and not obstructed. Check the mouth for objects (such as chewing gum, food, dentures, or the tongue) that can obstruct the flow of air
  - b Place the victim on his or her back, then put one hand under the victim's neck and the other hand on the victim's forehead
  - c Lift the neck with one hand  and press the forehead backward with the other hand

---

<sup>2</sup> If you want to be trained in giving this aid, ask a suitable organization (such as the Red Cross) in your area

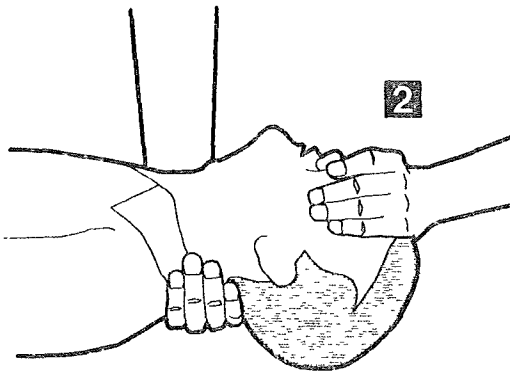


2 Look, listen and feel to determine if the victim is breathing freely

- a Put your cheek near the victim's mouth and nose
- b Listen and feel for the breathing-out of air At the same time, look at the victim's chest and upper abdomen to see if they move up and down

**If the victim is not breathing correctly and you decide that you want to give rescue breathing:**

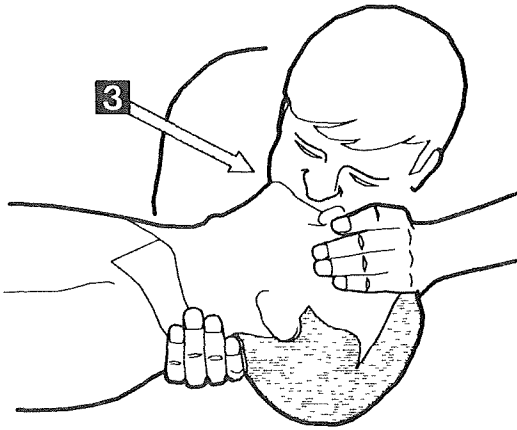
3 Continue to press on the victim's forehead with your hand and pinch together the victim's nostrils **2** with the thumb and finger



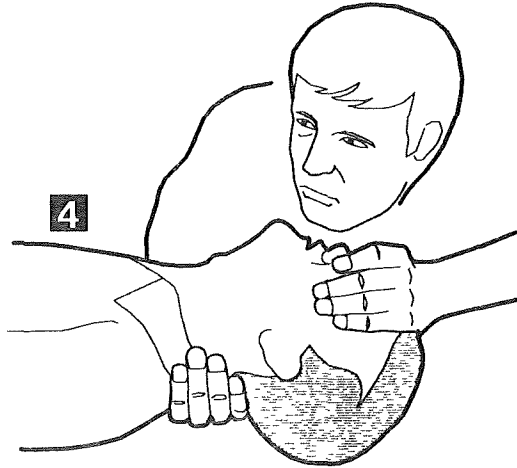
#### 4 CAUTION

Use extreme care when giving rescue breathing to a victim who possibly has breathed-in toxic fumes. *Do not breathe-in air that the victim has breathed-out.*

Open your mouth wide and take a deep breath. Make a tight seal with your mouth<sup>3</sup> around the victim's mouth **3** and blow into it.



- 5 Remove your mouth and let the victim breathe out while you check that the victim's chest **4** moves down.



- 6 Repeat steps 4 and 5 once every 5 seconds until the victim breathes normally again or until medical aid comes.

## Reporting Accidents

Report to your manager or to your IBM site all accidents, possible hazards, and accidents that nearly occurred.

*Remember* An accident that nearly occurred can be caused by a design problem. Quick reporting ensures quick solving of the problem.

Report also each small electric shock, because the conditions that caused it need only differ slightly to cause serious injury.

---

<sup>3</sup> A rescue-breathing face covering (mask) or similar unit can be used if you have been taught how to use it.



## **IBM PC Convertible Safety**

Observe the following precautions for the IBM PC Convertible when working with the Battery Pack, Internal Modem card, and the Liquid Crystal Display (LCD)

### **DANGER**

**Dispose of the Battery Pack in the trash. Do not dispose in an open fire, because the Battery Pack may explode.**

**Hazardous voltages may be on the Internal Modem card and the modem cable if the modem cable is not disconnected in the following order. A potential shock hazard exists.**

- 1. Disconnect the modem cable from the telephone wall outlet.**
- 2. Disconnect the modem cable from the system unit.**

**Dispose of the LCD in the trash. If the LCD is broken, wear rubber gloves to wipe any liquid with a wet cloth. Dispose of any broken glass and the wet cloth in the trash. Wash the gloves with soap and water.**



# Contents

<b>Unit 1: Introduction and Maintenance</b> .....	<b>1</b>
Session 1 Introduction and Operations . . . . .	1
Session 2 Maintenance . . . . .	37
<b>Unit 2: Diagnostic Strategies and Procedures</b> .....	<b>65</b>
Session 1 Maintenance Strategies . . . . .	65
Session 2: Customer Maintenance Package . . . . .	71
Session 3 Service Maintenance Package . . . . .	87
Session 4: Technical Support and Incident Reporting . . . . .	105
<b>Appendix A. Installation Instructions</b> .....	<b>109</b>
Student Opinion Questionnaire . . . . .	114
FIS Data Collection Sheet . . . . .	116
IBM PC Convertible - Student Quiz (Course 77479) . . . . .	117



# General Information

## Course Description

This course is designed for service representatives involved in the diagnosis and service of the IBM PC Convertible. Hardware locations and diagnostics of the basic system are included. Reference is also made to documentation that may be used during service activity.

## Prerequisites

There are no prerequisites for this course.

## Materials Required

Your branch office education administrator will provide you with the material necessary to complete this course. This includes the following:

Form No.	Description
----------	-------------

ZR28-0616	IBM PC Convertible Student Guide for course 77479
-----------	---

## Service Representative Ability Level

Following is a list of tasks that the service representative is expected to perform or know after taking this course. Each item is preceded by an ability level code to indicate the person's ability for that specific task.

- |   |              |
|---|--------------|
| 1 | Introductory |
| 2 | Working      |
| 3 | In-Depth     |

## Basic Skills

- |   |   |
|---|---|
| 1 | (1) Adhere to all safety practices when servicing the IBM PC Convertible.   |
| 2 | (1) Understand basic environmental/supply impacts on proper product operation.  |
| 3 | (1) Verify the customer Problem Determination Procedures to ensure that the customer performed them properly.         |
| 4 | (1) Operate stand-alone diagnostics and verify proper operation of all functional units.                              |
| 5 | (1) Locate all FRUs, cards, cables and connectors.  |
| 6 | (1) Use all service aids as directed by the maintenance documentation, to isolate and/or correct failure.             |
| 7 | (1) Perform all removals, replacements, adjustments, and service checks as directed by the maintenance documentation. |
| 8 | (1) Understand the product technical support structure.   |

9 (1) Understand the PC Convertible service terms and conditions.

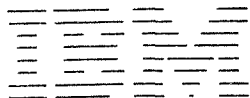
10 (1) Perform appropriate call reporting on the failing FRU or operation to allow accurate product tracking.

## Instructions to the Student

This self-study course should take you about 4.0 hours to complete. The course consists of two sessions in the first unit, four sessions in the second unit, and a student quiz. This manual will be your guide throughout the course. It contains all of the teaching material.

The entire course is taken off-terminal, using this Student Guide. The Student Opinion Questionnaire, Data Collection Sheet, and Student Quiz are located in the back of this manual. After completing the study material for this course, use the Data Collection Sheet to record your answers to the Student Opinion Questionnaire and Student Quiz. Then return the Data Collection Sheet to your branch office education administrator. An FIS terminal is required for the administrator to enter your quiz answers and the course evaluation data from the Data Collection Sheet.

The Course Map on the next page shows the course sessions and the approximate amount of time required for each session. Use this for a reference as you go through the course.



# FIS Course Map

IBM PC CONVERTIBLE

17479

Course Name (As It Appears in the RET Description File)

Course Number

Course is Available on FIS 111

Yes ☐ No ☒

Course Length    2 0    5 0    4 0  
                          Low       High       Average

Unit-Session/Topic

	Printer Requirements (See printer legend)	Student On-Terminal Time (Estimate)	Student Off-Terminal Time (Estimate)	Student Actual Time (Filled in by student)	Monitor Terminal Time (Estimate)	Media Requirements (See media legend)	Training Machine Required*
UNIT 1 INTRODUCTION AND MAINTENANCE							
SESSION 1 INTRODUCTION AND OPERATIONS			0 8				
SESSION 2 MAINTENANCE			0 5				
UNIT 2 DIAGNOSTIC STRATEGIES							
SESSION 1 MAINTENANCE STRATEGIES			0 3				
SESSION 2 CUSTOMER MAINTENANCE PACKAGE			0 7				
SESSION 3 SERVICE MAINTENANCE PACKAGE			1 0				
SESSION 4 TECHNICAL SUPPORT AND INCIDENT REPORTING			0 2				
STUDENT QUIZ			0 5				
Totals			4 0				

Media Legend

A 16mm Motion Film  
 B 8mm Motion Film  
 C Filmstrip  
 D Slides  
 E Microfiche  
 F Video Tape

G Audio Tape  
 H Mock-Up  
 J Simulator  
 K  
 L  
 M

Printer Legend

O Occasional Use  
 R Real Time (high priority)  
 S Printer Not Required

Sheet 1 of 1

\*Check if B/O Training Machine Required

ATL00169





# **Unit 1: Introduction and Maintenance**

## **Session 1: Introduction and Operations**

This session requires approximately 0.8 hours to complete

### **Introduction**

This session introduces you to the IBM PC Convertible, Machine Type 5140. You will learn about the two models available, and then the standard and optional features will be described.

Next, you will find out how the customer “gets started” using their new system. The installation and setup procedures will be discussed which includes showing the customer how to initially access the PC Convertible by using the Start-up diskette.

### **Objectives**

Upon completion of this session, using supporting documentation, you should be able to

1. Identify which components are standard and which are optional.
2. Discuss with the customer the documentation used to install their IBM PC Convertible. Also, understand how the customer initially accesses and operates the 5140 system.

### **Objective 1 - Product Description**

Identify which components are standard and which are optional.

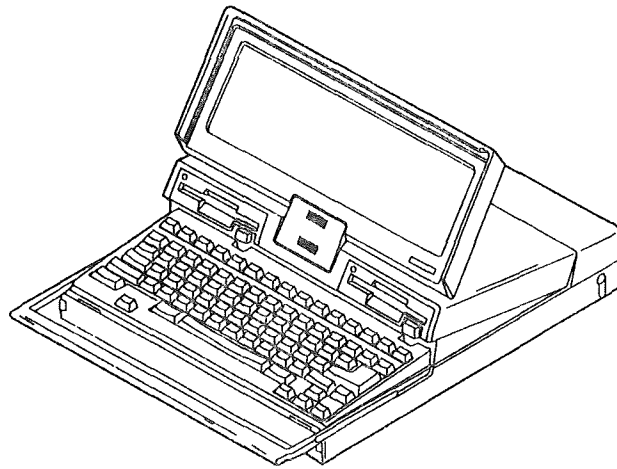
### **Highlights**

- System introduction
- Models
- Standard features
- Optional features

# Activity

## System Introduction

The IBM PC Convertible is a battery-operated, portable member of the IBM Personal Computer family. The PC Convertible system unit weighs 12 lbs and contains the following standard features: a processor, liquid crystal display (LCD), keyboard, power supply card, and a battery pack. The system also contains two 3.5-inch diskette drives and a minimum of 256Kb of internal memory. In addition, an AC adapter is provided for powering the system and recharging the battery pack.



ATL00042

The PC Convertible maintains compatibility with 5.25-inch diskette drive systems through either of two methods.

- Asynchronous Communications
- IBM PC 3.5" External Diskette Drive (Machine Type 4865)

Asynchronous communications is performed by either of two feature options: the Internal Modem and/or the Serial/Parallel adapter. Each of these options will be discussed later in this session.

The IBM PC 3.5" External Diskette Drive option attaches directly to an existing PC and is covered in the Condensed Operations and Maintenance Procedures (COMP) course, 40470.

## Models

The 5140 system unit comes in two models. Model 002 and Model 022.

**Model 002** includes both hardware components and software programs. The standard features and software programs included are.

### Hardware

- 80C88 CMOS microprocessor
- 64Kb ROM
- 256Kb RAM
- LCD
- Keyboard
- Power Supply card
- AC adapter
- Battery pack
- Two 3 5-inch diskette drives
- I/O Feature connector

### Software

- Start-up Diskette which includes:
  - Application Selector
  - SystemApps
  - Tools
  - Exploring the IBM PC Convertible
  - Diagnostics

**Model 022** is the hardware-only version of the PC Convertible. It consists of all the above listed items except the three software programs “Application Selector,” “SystemApps,” and “Tools”.

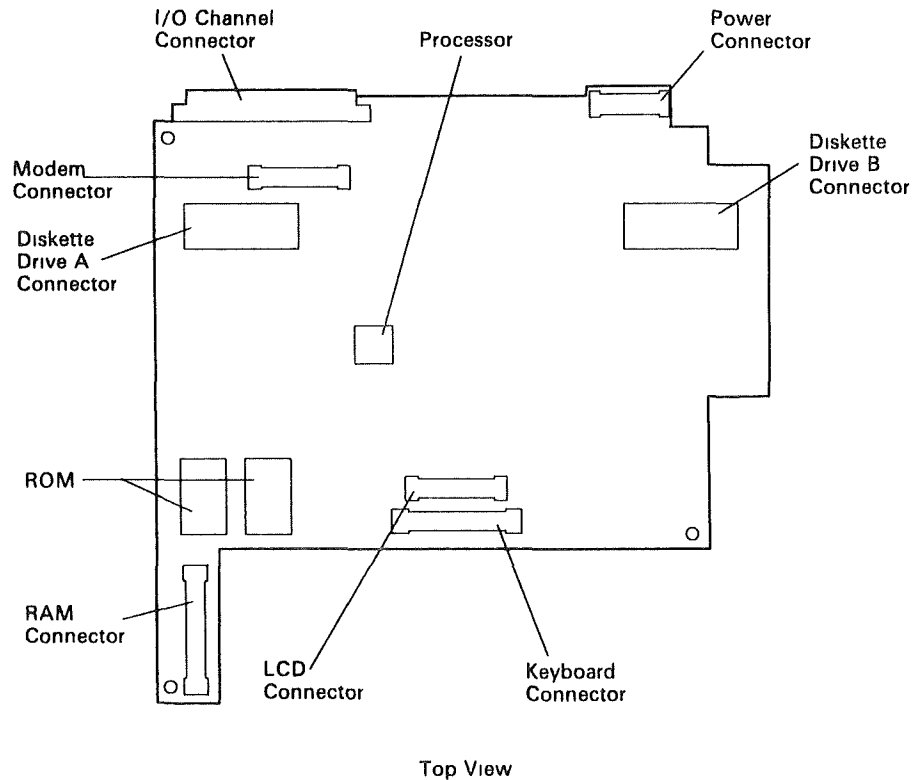
Notice that the “Exploring” and “Diagnostics” programs are included with the Model 022. “Exploring” familiarizes the customer with their new PC Convertible, and “Diagnostics” are used to check out the system. These programs will be discussed later in this session.

Both models can be expanded to a maximum of 512Kb RAM via 128Kb RAM cards.

## Standard Features

Below is a diagram of the System Board and all the connectors for the 5140's standard features.

### System Board



ATL00043

### Processor

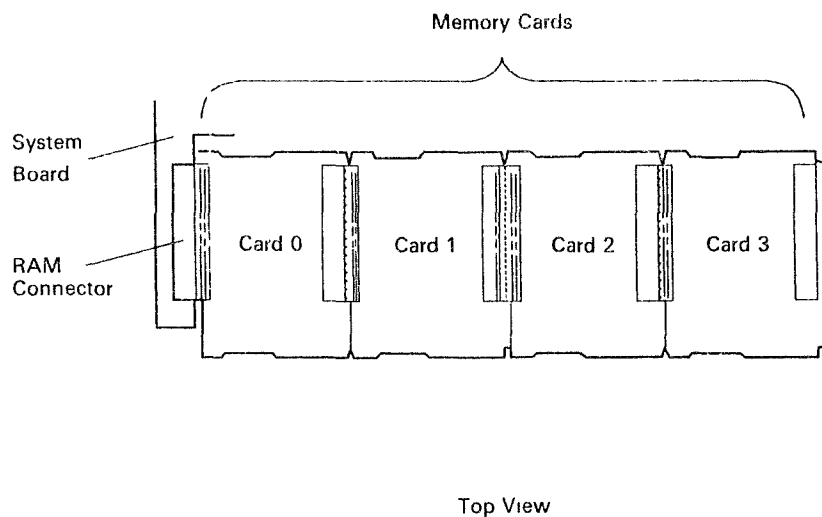
The IBM PC Convertible processor is an 80C88 Microprocessor located on the system board. It accomplishes all the processing and controlling operations for the system through sets of instructions called programs.

### Read Only Memory (ROM)

Also located on the system board are two 32K by 8-bit modules of read-only memory (ROM). ROM permanently stores three "programs" that the customer can call up at any time:

- Power-on self-test (POST)
- Resident BASIC
- Basic input/output system (BIOS)

## Random Access Memory (RAM)



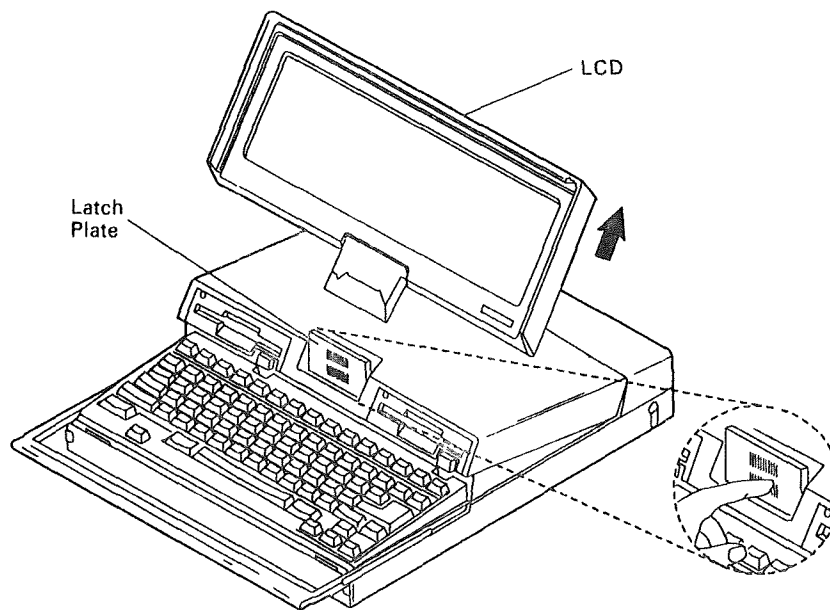
ATL00104

The minimum amount of RAM is two 128K-byte cards (Cards 0 and 1 above) totaling 256Kb. A maximum of four memory cards (including the cards shipped in the system unit) can be installed within the 5140. The above drawing shows four RAM cards plugged together which is 512Kb. The system automatically calculates the amount of RAM installed when the system is powered on.

The leftmost card (Card 0) is attached to the system board. When removing these cards from the system, the rightmost card (Card 3) must be removed first, then Card 2, and so on.

RAM is used to electronically store application programs and user data. All information in RAM is lost when power is removed.

## Liquid Crystal Display (LCD)



ATL00105

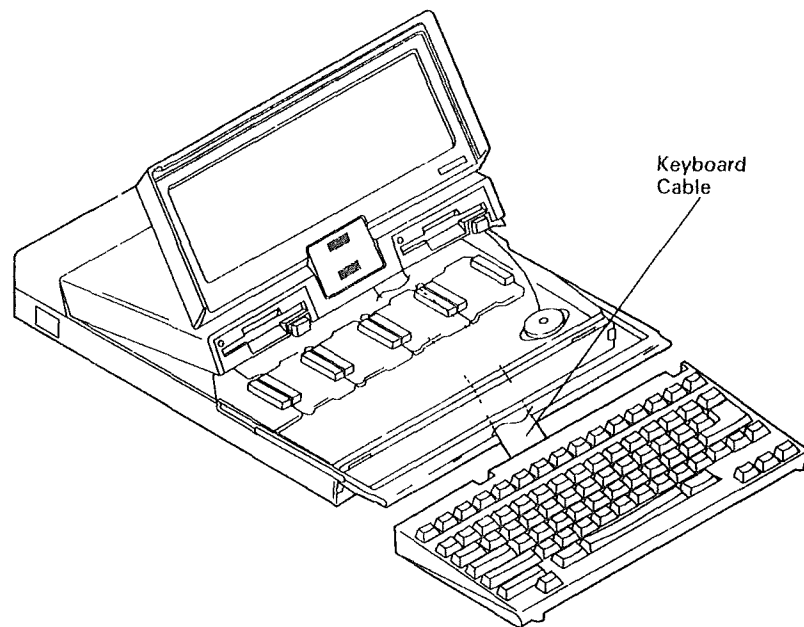
The PC Convertible display is a 25-line, 80-column, dot matrix, liquid crystal display (LCD). The LCD can easily be removed to attach an optional display, such as the IBM Monochrome Display.

The above picture shows how to remove the LCD. First, the lower portion of the latch plate is pressed, releasing the LCD from the system. Then the LCD is lifted from the system unit and a separate LCD yoke cover is used to slide onto the empty spot.

### IBM Monochrome Display (Feature)

The IBM 5144 Monochrome Display is an optional feature that can be attached to the IBM PC Convertible. It provides a higher degree of readability than the LCD. While the 5140 system is designed for ease of portability, this monitor is expected to remain stationary on the user's desk. You will read more about it later in this session.

## Keyboard

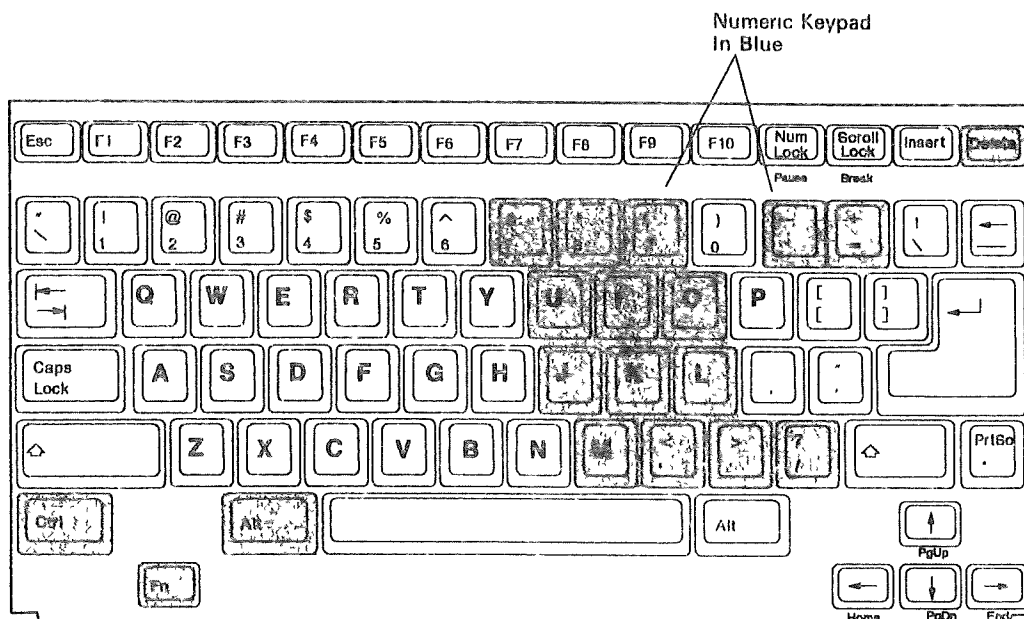


View with Keyboard Removed

ATL00044

The keyboard is a field replaceable unit (FRU) consisting of 78 keys (79 for World Trade), a printed circuit board, and a cable to attach it to the system board

The keyboard is an integral part of the 5140 System Unit. When the LCD is lifted into operating position, the keyboard tilts up at the rear.



78-key Keyboard

ATL00045

A **numeric keypad** provides a calculator-like pad for entering numbers in application programs. It includes numbers, operators (-, +, /, and \*), and punctuation. The numeric keypad numbers are etched in blue on the front of the keybuttons

Pressing **Fn + Num Lock** once activates the numeric keypad. Pressing **Fn + Num Lock** again deactivates the numeric keypad. (Fn is a "Function" key used with another key to perform a command or function. Num Lock is numeric lock.) Holding down the Fn key temporarily switches the numeric keypad between alphabetic and numeric. Releasing the Fn key resumes the current state.

Two other key combinations that are important to know are **Ctrl + Fn + Del** and **Ctrl + Alt + Del**. (A key combination means that the keys should all be pressed at the same time – simultaneously )

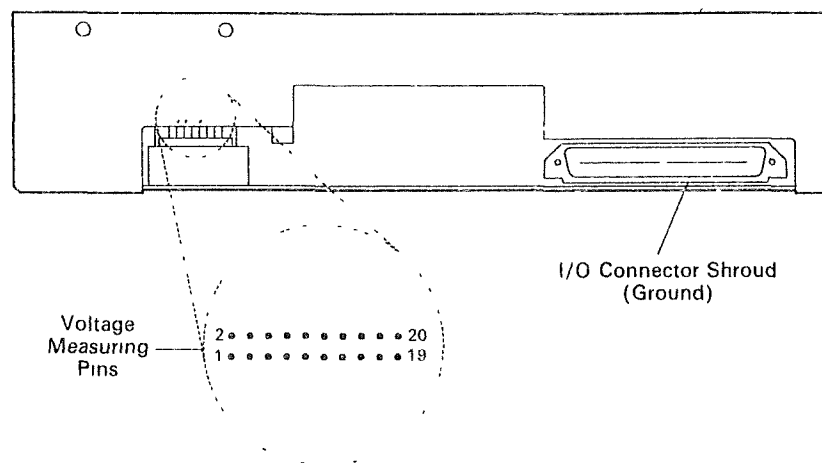
The **Ctrl + Fn + Del** combination resets all the system hardware, executes all power-on self-tests, and loads (IPLs) the system programs from the diskette in drive A.

The **Ctrl + Alt + Del** combination only loads (IPLs) the system programs from the diskette in drive A



## Power Supply Card

The power supply is a 12-watt card that provides five voltage levels of power to the system unit and its attachments. Due to the low power dissipation, no cooling fan is required in the system unit.



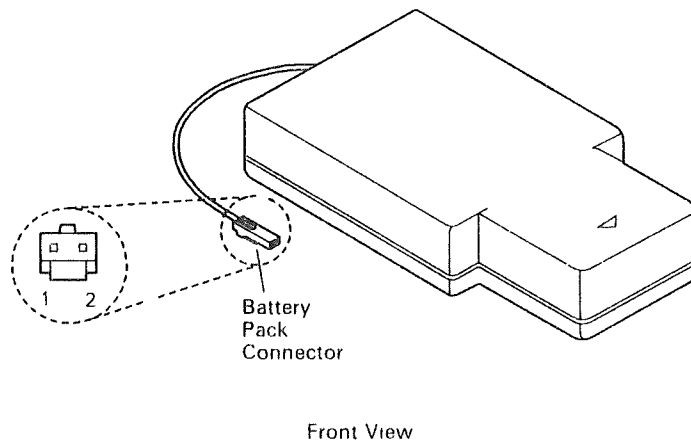
Rear View  
Non-component Side

ATL00046

This picture shows what the power supply card looks like with the rear cover removed, and where to measure voltages when directed by the Problem Isolation Charts (PICs) (The PICs will be discussed in the next unit ) When measuring voltages here, use the shroud on the I/O connector for ground.

The power supply card accepts input from four sources: a battery pack, an AC adapter, an automobile power adapter, or a battery charger. The AC adapter and the automobile power adapter charge the battery pack while simultaneously powering the system unit. The battery charger only charges the battery pack.

## Battery Pack



ATL00047

The 5140 Battery Pack contains eight rechargeable Nickel Cadmium (NiCad) cells packaged into a single unit. It slides inside the system unit and plugs onto the power supply card under the units' covers. One battery pack is provided with each system unit.

A battery pack is estimated to last two to four years with normal usage. When fully charged, the battery pack will provide approximately 6 to 10 hours of operation. Battery life depends on the amount of memory installed, usage of the diskette drives, printer, and internal modem, and whether the LCD and system stay on during periods of inactivity.

The battery pack is covered under the 12-month warranty, but is not covered under the IBM Post-Warranty Service Agreement or Dealer Service Option (DSO).

The customer can save battery power by changing the "Battery-Saving Option" in the System Profile. The System Profile is on the Start-up diskette which will be discussed later.

## Battery Charge Times

The battery will need to be charged for 24 hours before using it for the **first** time

Subsequent charge times depend on the amount of use. When the 5140 beeps the low-battery warning, the battery will need to be charged for 12 to 14 hours before using the system on battery power again.

The battery pack should be disconnected when the customer doesn't plan to use the system for a long period of time. Then, before using it again, the customer should charge the battery for 24 hours.

The battery accepts a charge most effectively when the temperature range is 5°C to 25°C (41°F to 77°F). When the system unit is cold, it takes longer to charge. The battery does not accept a charge below 0°C (32°F).

## Low Battery Warning

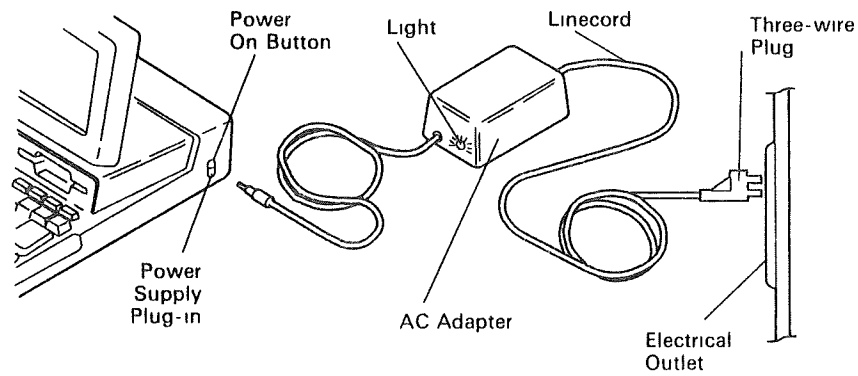
When the PC Convertible is powered by the battery and the battery power is low when it is turned on, the system beeps three times and automatically powers off.

If the battery power becomes low while the system is being used, it beeps three times and the display flashes. Pressing a key clears the warning.

- If a key is **not** pressed, the system automatically powers off after two minutes. The contents of memory are retained. When the system is powered back on, it resumes from the point where it powered off.
- If a key is pressed, the warning is repeated in two minutes. However, if a key is continually being pressed and the low battery condition is not corrected, the system will completely lose power. If the system completely loses power, all data in memory is lost.

*Note:* If possible, always have the customer attempt to save the contents of memory until the battery can be recharged or connected to the AC adapter.

## AC Adapter



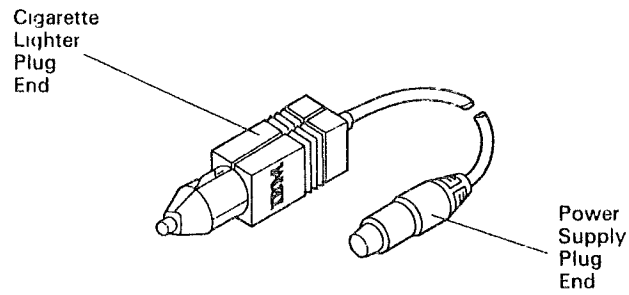
ATL00048

The AC Adapter is designed to be used by the PC Convertible to power the system unit while simultaneously charging the battery pack. It is provided with the system unit as a power supply package consisting of a cord extending from each end.

The cord, which plugs into the wall outlet, is removable and can be ordered for either 110 or 220 volt AC operation.

The cord on the other side of the AC adapter plugs directly into the power supply card and is not removable. The power supply plug-in is located just below the power-on button.

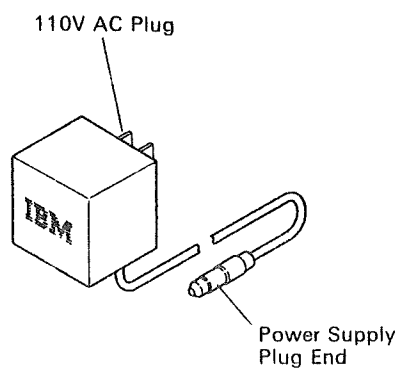
## Automobile Power Adapter (Feature)



ATL00049

The 5140 Automobile Power Adapter powers the system unit while simultaneously charging the system battery pack. The adapter attaches, on one end, to the system units' power supply card (located just below the power button). The other end plugs into the cigarette lighter outlet in a vehicle with a 12-volt negative-ground electrical system.

## Battery Charger (Feature)

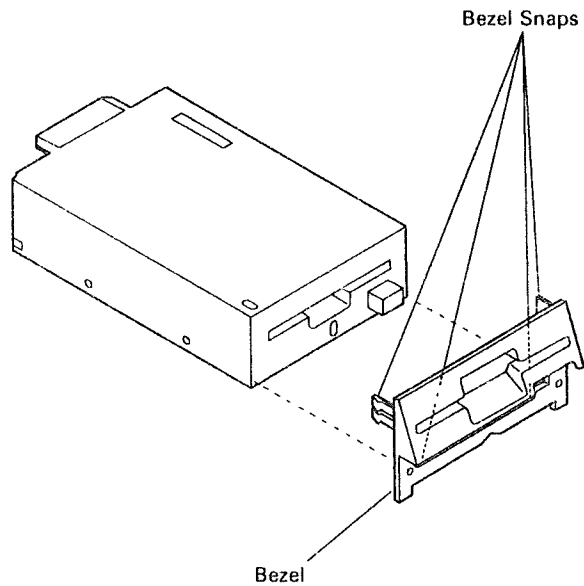


ATL00050

A battery charger is also available to charge the battery, but not while powering the system. It does not provide sufficient power output to allow system operation while the batteries are being charged. It is used to "trickle" charge the battery pack.

The charger attaches on one end to the system units' power supply card (located just below the power button). The other end plugs into a 110-volt AC wall outlet.

### 3.5-inch Diskette Drive



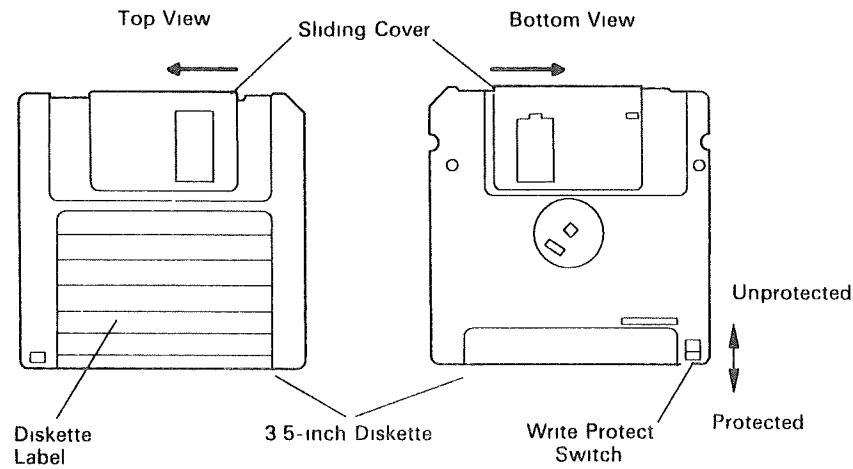
ATL00051

The PC Convertible comes equipped with two diskette drives. The drive unit is a fully self-contained field replaceable unit (FRU) that consists of spindle drive, head positioning and read/write/erase systems.

The bezel is a cover that snaps onto the front of the diskette drive unit. When replacing the diskette drive, remove the bezel from the old drive and install it on the new one.

Each diskette drive supports 90-millimeter (3.5-inch) double-sided diskettes.

## Diskettes



ATL00052

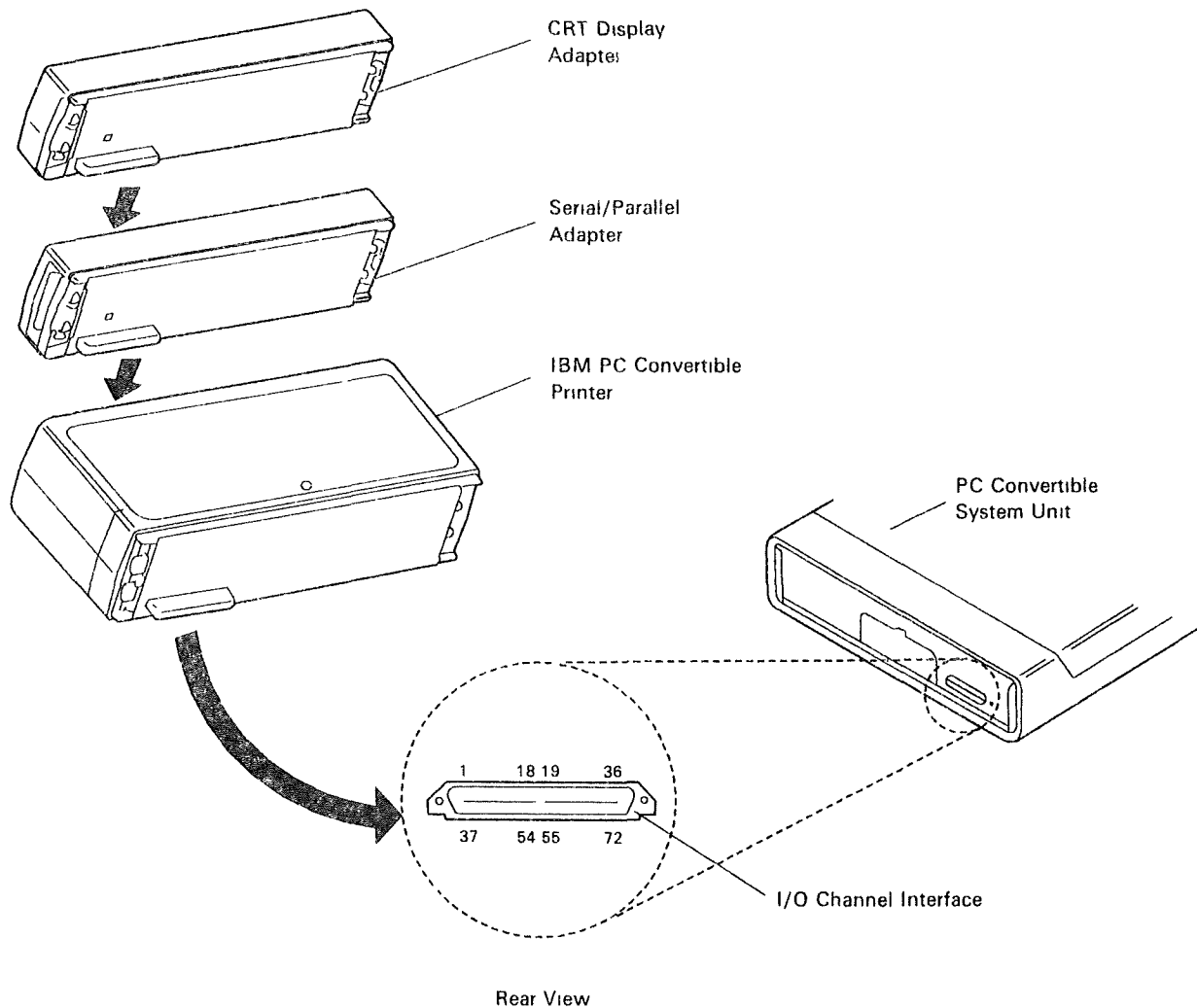
The 3.5-inch diskettes used by the 5140 diskette drives are double-sided, high-capacity (720Kb formatted) diskettes and are a customer-supplied item. Each diskette is housed in a rigid plastic case containing a built-in write protect switch. A spring-loaded sliding cover allows access to the read/write heads only (thus protecting the diskette surface from finger prints, dust, and other environmental contamination).

A diskette is loaded into the drive by inserting it into the slot with the diskette label facing up.

Compared with the PC's 5.25-inch diskettes of 360Kb, the 3.5-inch diskette holds twice as much data and is almost two inches smaller.



## I/O Channel Interface



ATL00053

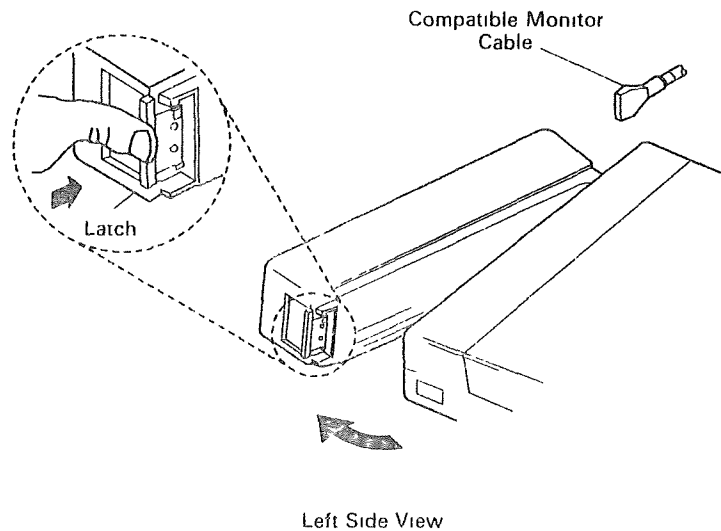
At the rear of the 5140 System Unit is the 72-pin I/O Channel Interface connector. This connector allows any or all of the following optional features to connect to the system unit (either separately or at the same time).

- CRT Display adapter
- IBM PC Convertible Printer
- Serial/Parallel adapter

Each of these devices is powered from the system unit. The CRT Display adapter requires the system to be powered by the AC adapter. These I/O devices will be discussed next.

## Optional Features

### CRT Display Adapter

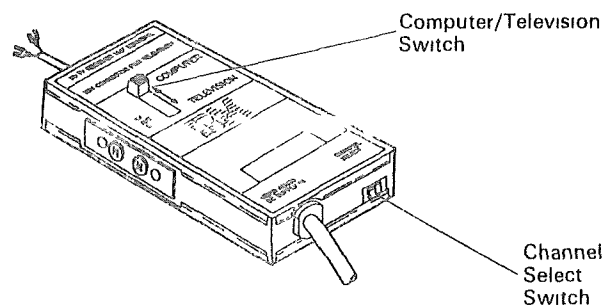


ATL00054

The IBM CRT Display adapter is a feature that provides the interface required to attach compatible direct drive monitors (such as a 5153 PC Color Display) or composite monitors (such as the 5144 Monochrome Display) to the 5140 System Unit.

In addition, this feature allows a television set to be connected to the 5140 System Unit when a radio frequency modulator (TV connector) is used.

### Television Connector Cable

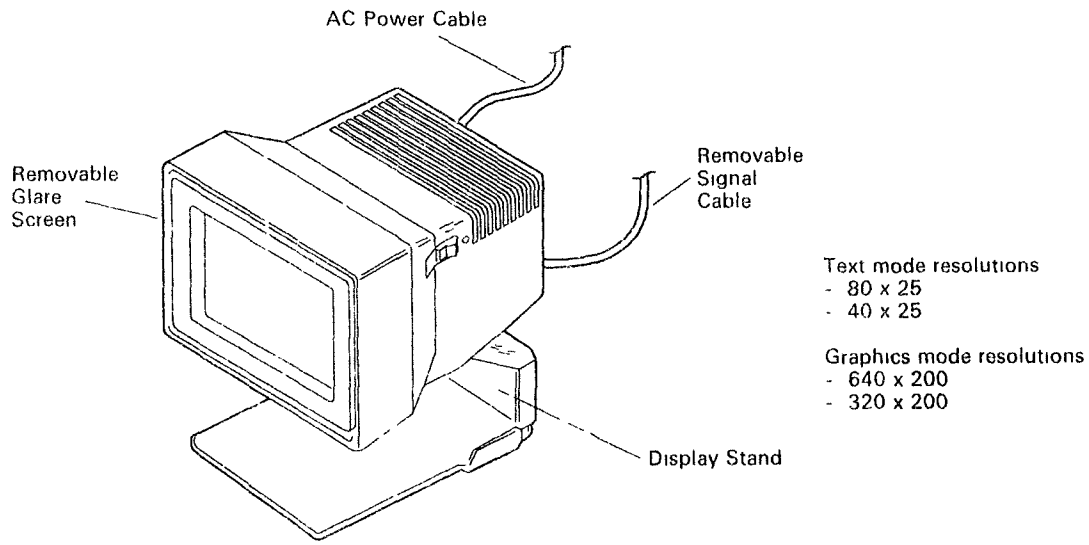


ATL00055

The television connector cable is a sealed radio frequency (rf) modulator that imposes the composite video and audio signals onto the rf carrier wave generated by the modulator. The connector unit has two 2-position switches. One switch selects between the output of the system or a standard television antenna. The other switch selects either channel 3 or channel 4 carrier-wave frequency.

*Note:* When any CRT Display (or television set - U S only) is attached via the CRT Display adapter, the display requires its own power source.

## PC Convertible Monochrome Display (Machine Type 5144)

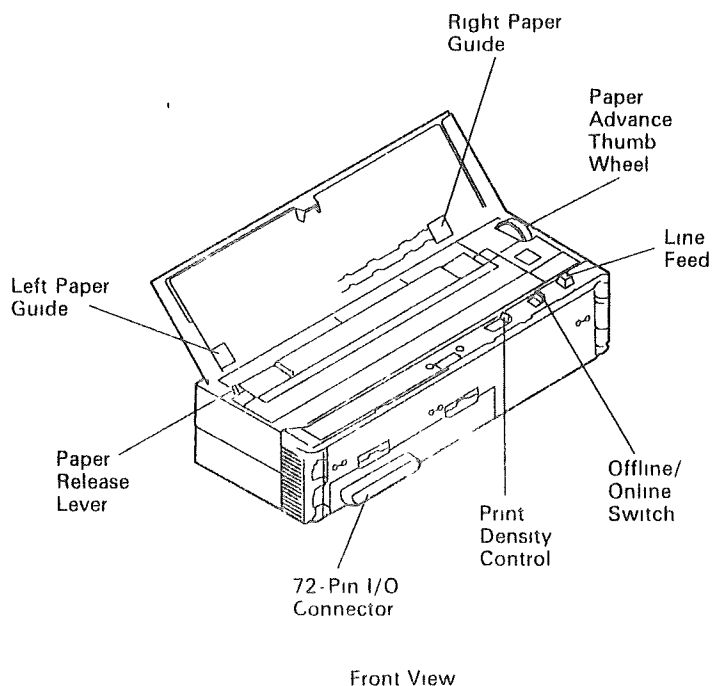


ATL00056

The IBM 5144 Monochrome Display is a nine-inch (measured diagonally) composite video monitor, which is attached to the 5140 System Unit via the CRT Display adapter and a signal cable. The display stand, AC power cable, removable signal cable, and high contrast filter (glare screen) are provided with the display.

The display stand serves two purposes: 1) for ease of reading, and 2) to slide the 5140 System Unit underneath the screen either in close quarters or because of personal preference.

## IBM PC Convertible Printer



ATL00057

The PC Convertible Printer is a low-power, thermal, serial dot matrix printer. It is a feature that attaches to the back of the system unit. If additional optional features are installed, the printer must be the first feature attached to the back of the system unit. There is a notch in the latching area to prevent it from hooking to the back of another optional feature.

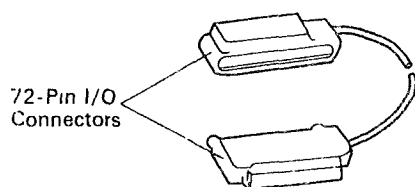
An optional cable is available that allows the printer to be used near the system unit. Printing speed (in ten pitch) is approximately 40 characters per second (cps) burst.

In addition to the standard ASCII character set, the printer can print in bit-image graphics. The Standard ASCII 96 character, uppercase and lowercase character sets are printed using a high resolution 24-element print head. Graphics are printed using an all points addressable (APA) print mode.

Near Letter Quality (NLQ) printing can be accomplished using either a thermal transfer ribbon on "smooth" (60 Sheffield units, maximum) paper, or no ribbon on heat sensitive thermal paper.

Draft Quality may be achieved using the thermal transfer ribbon on "IBM Multi-System Paper" or equivalent.

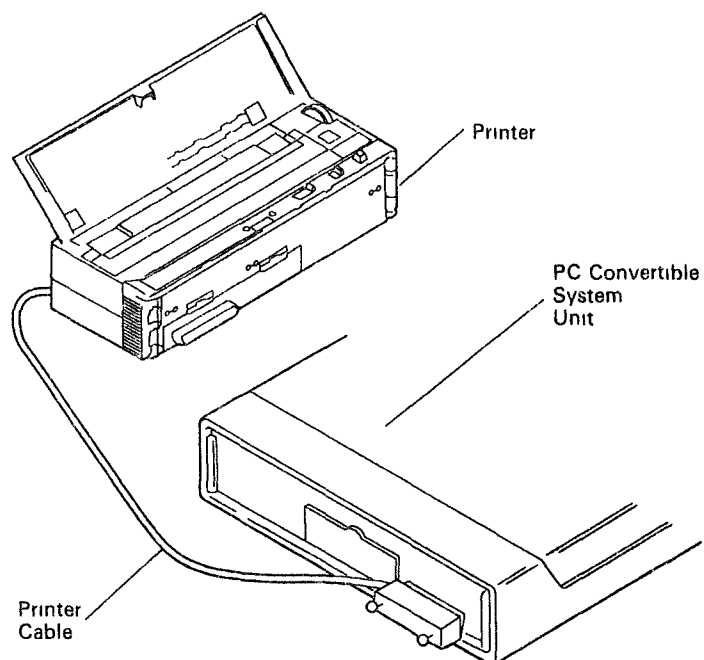
## Printer Cable



ATL00058

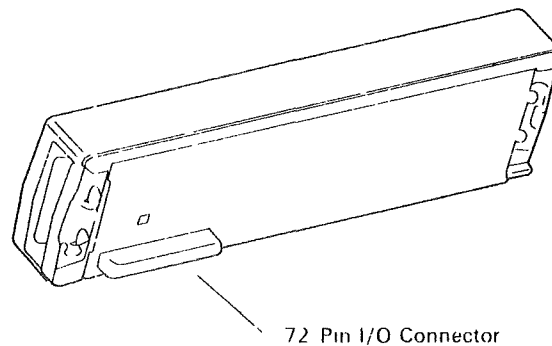
The PC Convertible Printer Cable is an option 600 mm (23.5-in) in length with a 72-pin I/O connector attached to each end. It allows the printer to be used on either the left or right side of the system unit. The cable connects to the printer on one end, and to the back of the system unit on the other.

No additional adapters may be attached to the back of the printer when the printer is cable-connected to the 5140 System Unit.



ATL00059

## Serial/Parallel Adapter

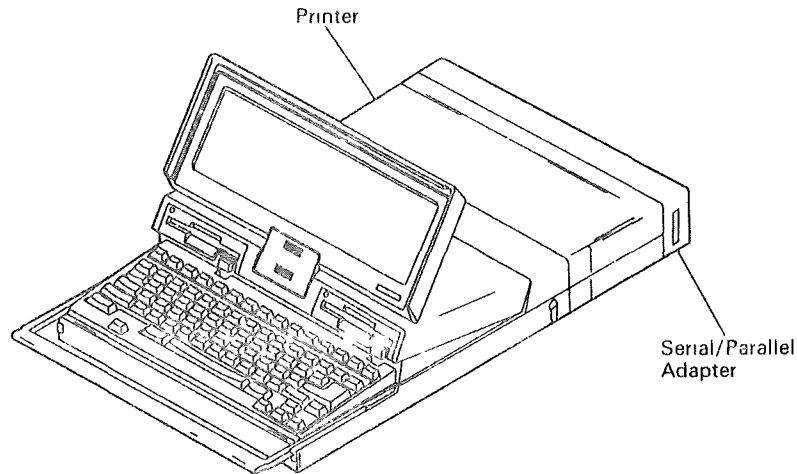


ATL00060

The Serial/Parallel adapter is a feature that provides both a serial (RS232C) communications adapter and a parallel communications interface adapter in a single module. These adapters share a common system interface. However, the functions of each are logically separate and are described in two parts.

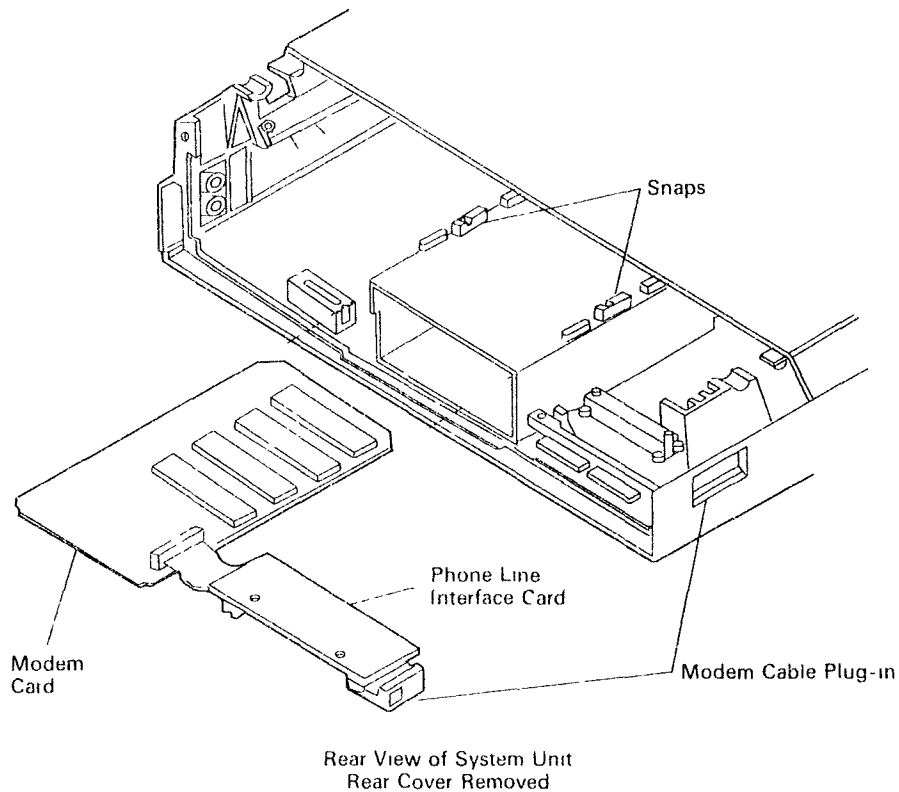
The serial (or asynchronous) adapter provides an RS232C interface that is compatible with applications written for the IBM Personal Computer Asynchronous Communications Adapter.

The parallel communications interface adapter is specifically designed to attach printers with a parallel port interface. It can also be used as a general purpose input/output port for any device or application which matches its input/output capabilities.



ATL00061

## Internal Modem



ATL00062

This option provides the capability for telecommunications between the 5140 and another compatible device over telephone lines. It is connected to the system board and can be programmed to operate at line speeds of 1200, 300, or 110 bits per second. It uses modulation methods and frequency tolerances equivalent to either the Bell 212A or Bell 103A.

The Internal Modem consists of two major elements: the asynchronous communication element (Phone Line Interface Card) and the modulator/demodulator element (Modem Card). It is offered as a complete assembly with a cable connecting the two cards. It is designed for U.S. use only and the entire assembly is customer installable under the covers of the system unit.

## Other Supported Options

The currently available IBM Personal Computer Options that are supported on the IBM PC Convertible are

- IBM 5152 Graphics Printer
- IBM 4201 Proprinter
- IBM Personal Computer Printer Cable
- IBM 5153 Personal Computer Color Display
- IBM PCjr Adapter Cable for the IBM Color Display
- IBM 4863 "PCjr" Color Display
- IBM Communications Adapter Cable



## Objective 2 - Getting Started

Discuss with the customer the documentation used to install their IBM PC Convertible. Also, understand how the customer initially accesses and operates the 5140 system.

### Highlights

- Customer Documentation, Installation, and Responsibilities
- Start-up Diskette
- Powering on the System
- What to do

### Activity

#### Customer Documentation, Installation, and Responsibilities

A *Guide to Operations* (GTO) manual, and a **Start-up** diskette are shipped with the IBM PC Convertible.

Instructions for **unpacking** the 5140 system are printed on the inside of the shipping box lid. The **set-up** instructions are placed inside the shipping box, on top of the system unit. Appendix A shows you what the set-up instructions look like.

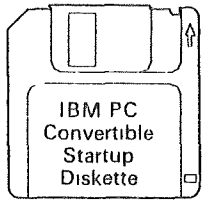
If the customer requires assistance during setup, they should first contact their point-of-sale (POS) representative.

It is the customer's responsibility to ensure:

- Adequate site preparation
- Unpacking/placement
- Physical setup/connection of cables
- Problem determination/use of PDPs
- Optional feature attachment/personalization.

So if a customer calls for help, ensure that they have reviewed the GTO or called the POS for assistance.

### Start-up Diskette



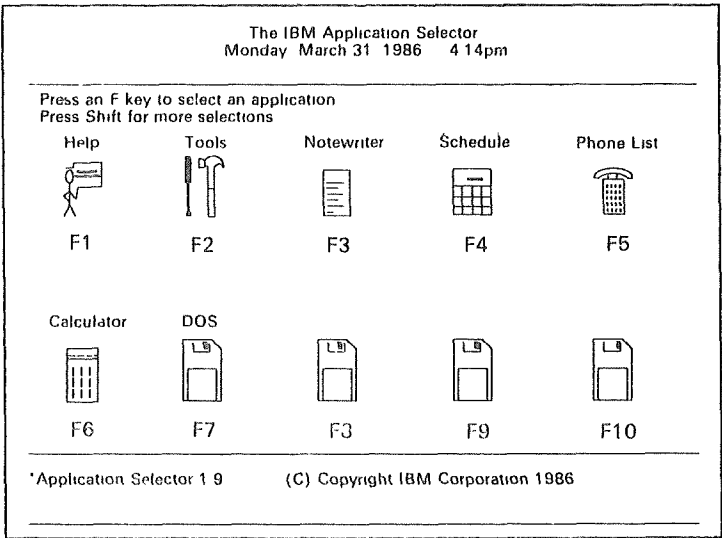
- Application Selector\*
- SystemApps\*
- Tools\*
- Exploring
- Diagnostics

\* Model 002 only

ATL00063

The Start-up diskette is included with the GTO. A software set-up program on the Start-up diskette directs the user to create a System/Applications diskette that contains the “Application Selector”, “SystemApps”, “Tools” and to optionally merge DOS 3.2 (purchased separately). The Start-up diskette also includes “Exploring the IBM PC Convertible” and the customer diagnostic routines

### Application Selector Menu

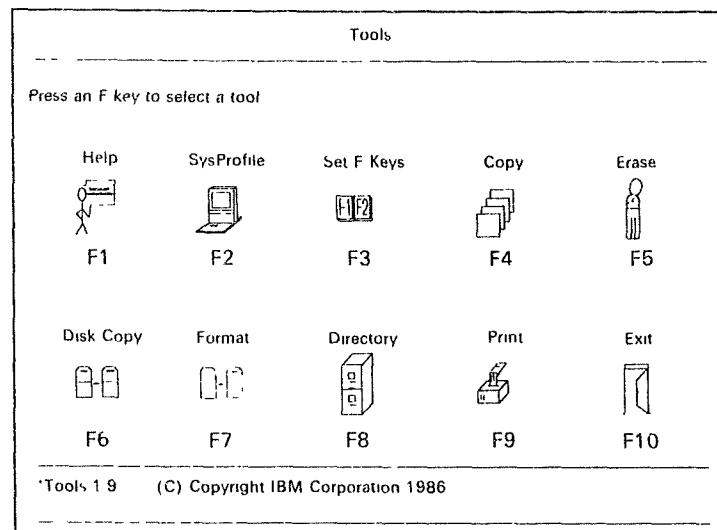


ATL00064

The “Application Selector” is created when the customer runs the software setup program on the Start-up diskette. The Application Selector menu shows the F keys used to load SystemApps, Tools, and other applications specified by the customer.

The "SystemApps" are programs the customer selects from the Application Selector Menu that helps them to write notes, keep a schedule, keep a phone list, and do calculations. The applications are called: "Notewriter," "Schedule," "Phone List," and "Calculator"

## Tools Menu



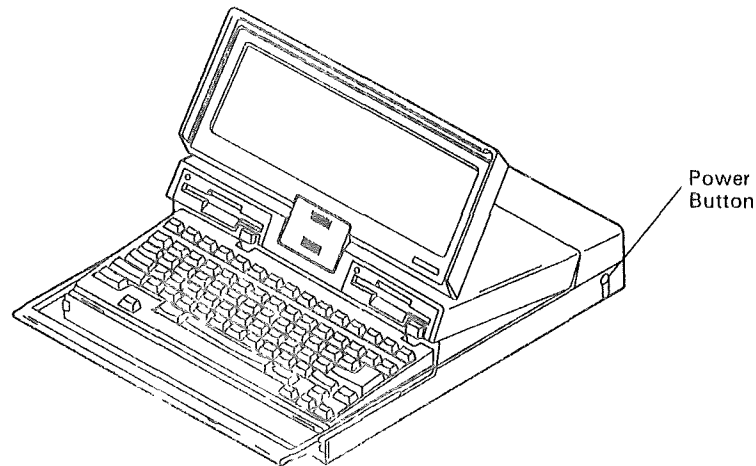
ATL00065

"Tools" is a menu-driven program which allows the user to perform a series of functions needed to control and maintain the system, such as copying and erasing files, copying diskettes, etc. If DOS 3.2 is (separately purchased and) merged per the software set-up program, additional functions become available, including printing, formatting diskettes and other DOS functions.

"Exploring the PC Convertible" is designed to familiarize a user with the system unit and the software. The program consists of screens employing graphic pictures, animation, and simulations of software screens. The user is often asked to interact with the program, which takes approximately one hour to complete. The "Exploring" program is not operable when using a television set (attached via the CRT Display adapter) as the monitor.

"Diagnostics" are used when the problem determination procedures tell the customer to run them. Later in this course, you will learn more about how the diagnostics are run. Just be aware that they are on the Start-up diskette.

## Powering on the System



ATL00066

To begin using the PC Convertible system, press the red power button on the right rear of the system unit (as shown above). A short, low tone sounds and a power-on self-test (POST) runs. The short, low tone indicates that the system has actually been turned ON.

If the short, low tone is not heard, the system may have been powered OFF instead of ON. This is because the battery-saving options may have been set so that the LCD shuts off to save power. Push the button a second time to power the system back ON.

The POST is successful if the system beeps once (not the short, low tone at power-on time) and either “resumes” operation or “IPLs” (loads the system programs from the system diskette in drive A). Resume and IPL are power-on options.

If POST is not successful, the customer will hear more than one beep, and an icon (picture) will show on the screen. The beeps are what we call an audio response. The icons are pictures that are warnings explaining a condition that needs attention.

## Battery-Saving Options

The battery-saving options are part of the System Profile and are set by the customer. The System Profile is located on the Start-up diskette, and can be updated by selecting system profile from the Tools menu.

As the name indicates, this option saves battery power by turning off parts of the system that draw power even when not in use. These options are ignored when the AC adapter or automobile power adapter is attached.

The three battery-saving options that the customer can set are:

Run Serial/Parallel adapter on battery	(YES/NO)
Automatic power-off	(0/1-255 min)
Automatic LCD blanking	(0/1-255 min)

**Run Serial/Parallel adapter on battery** turns off power to the Serial/Parallel adapter if the NO option is chosen. To use the Serial/Parallel adapter, choose YES or attach and plug in the AC adapter or automobile power adapter.

**Automatic power-off** powers off the system after a specified amount of time (1-255 minutes) with no keyboard or diskette activity.

**Automatic LCD blanking** turns off the LCD when the keyboard has not been used for the amount of time you specify (1-255 minutes).

When the LCD is blank, do the following to determine whether the system is off or on:

1. Press the Fn (function) key to turn on the LCD.
2. Adjust the display contrast control to ensure that any characters on the LCD are visible.

If the LCD remains blank, the system is off. Press the power button once to power it on. When the system is powered on, a short, low tone sounds, and the POST runs.

## **Power-on Option (IPL and Resume)**

The Power-on Option is also a part of the System Profile and is set by the customer. The Power-on Option can be updated by selecting System Profile at the Tools menu.

With this option, the customer can either clear or retain the contents of memory when powering off the system.

When Power-on Option = IPL, the contents of memory are lost when you power-off the system. When you power the system back on, it IPLs the application from the system diskette in drive A (left drive).

When Power-on Option = RESUME, the contents of memory are retained when you power off the system. When you power the system back on, it resumes from the point where you powered it off. If you want to clear the contents of memory while this option is resume, you can manually IPL the system by simultaneously pressing the Ctrl + Alt + Del keys (Control + Alternate + Delete).

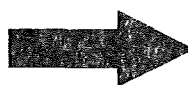
*Note.* When the CRT Display adapter is attached, you cannot use Power-on Option = RESUME. In resume mode, when the 5140 system is powered off, the LCD controller saves the read/write registers. Then when the system is powered on, the r/w registers are restored to the LCD display. The CRT Display adapter does not use r/w registers so, consequently, the display buffer cannot be saved when the system is powered off. Therefore, when the system is powered back on, Resume goes to look for the registers and can't find them.

## Audio Responses (Beeps)

An audio response is the same thing as a beep. Beeps let you know if the system check out has completed correctly. If one short beep is heard, the system check out is good. (The low, short tone at power-on is not counted as a beep.)

It is important to note the number and duration of the beeps. If an error occurs, the system will beep more than once. Suppose after powering on the 5140 System Unit, the customer hears three short beeps. The POST Audio Response Table (shown below) located in the GTO and HMS, tells what the beeps mean.

**POST Audio Response Table**



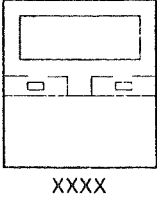
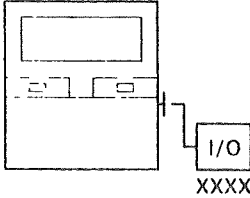
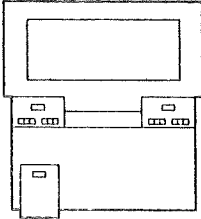
Response	Meaning
1 short beep	The POST has completed correctly.
2 short beeps	An error has occurred but the system is operational.
1 long beep + 1 short beep	An error has occurred and the system is not operational.
1 long beep + 2 short beeps	The LCD is not installed or the LCD controller is bad, and the CRT Display adapter is not installed or is not operational. The system automatically powers off.
3 short beeps	The battery pack is low and no external power source is connected to the system. The system automatically powers off.
No beep	The POST cannot run or the speaker failed.

Audio responses such as these are beneficial to you as a service representative because diagnosing a problem over the phone will be easier. If a customer calls for service and tells you they heard three short beeps, you can ask them questions like, "What did the POST Audio Response Table say?" or "Have you been through the PDPs in the GTO?" And if you know what three beeps means you can ask, "Did you check your battery pack?"

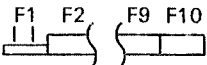
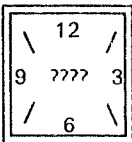

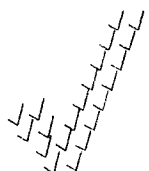
## Icons

An icon is a graphic display that tells you about the condition of the system. The following table describes the meaning of the icons displayed by the PC Convertible

### POST Icons

Icon	Meaning
<p>System Unit XXX Kb OK</p> 	<p>A POST error was detected in the system unit. The error code or codes indicate the failing area</p>
<p>Options XXX Kb OK</p> 	<p>A POST error was detected on an adapter or attachment that is not in the system unit. The error code or codes and the read-only memory (ROM) address indicate the failing area.</p>
<p>Insert Diskette A</p> 	<p>There is no diskette in drive A. The F1 prompt also displays with the icon</p> <p>If a broken diskette occurs with this icon, it indicates a diskette read failure.</p>



Icon	Meaning
<b>F1 Prompt</b> 	An error or warning condition has occurred, but does not prevent the system from operating. However, the device that caused the condition may not function correctly.
<b>System Clock</b> 	The system clock is incorrect. It may not have been set or is incorrect because power was lost. The system time is invalid and the system profile is set to the default state
<b>Low Battery</b> 	<p>The battery is too low to operate the system without the AC adapter or automobile power adapter installed.</p> <p>If the AC adapter or automobile power adapter is not installed, the system gives three short beeps and powers off without displaying any message.</p> <p><i>Note:</i> The battery takes about 24 hours to completely charge</p>
<b>I/O Channel Check</b> 	An I/O channel check has occurred.

## What To Do

In the very first part of the *Guide to Operations* manual, there is a section called "What To Do." This section tells the customer how to make their IBM PC Convertible operational. Here is what they do:

1. The set-up instructions, included with the system, show how to install the battery pack, insert the Start-up diskette, and install the AC adapter to charge the battery pack and power the system.
2. The set-up instructions, included with the printer and adapters, if any, show how to attach them to the system
3. With the Start-up diskette inserted, the system is powered on, and the customer is asked to go through "Exploring" for an introduction to the system.
4. With the Start-up diskette inserted, a system diskette is created by going through the software set-up program. This diskette will contain the Application Selector program, SystemApps, Tools, and optionally, the IBM Disk Operating System (DOS). The system diskette will be called the Application Selector (App/Selector) diskette
5. After loading the new App/Selector diskette, the customer is asked to set the system date, time and the hardware options.

## Study Questions

- 1 Which list of FRUs are the standard features for the PC Convertible?
  - a Processor, RAM, battery pack, monochrome display, AC adapter, two 3.5-inch diskette drives, keyboard, power supply card, and the I/O channel interface connector
  - b Battery pack, battery charger, power supply card, keyboard, ROM, RAM, LCD, two 3.5-inch diskette drives, and the I/O channel interface connector.
  - c Processor, battery pack, ROM, keyboard, RAM, two 3.5-inch diskette drives, LCD, AC adapter, I/O channel interface connector, and the automobile power adapter.
  - d Keyboard, power supply card, AC adapter, battery pack, ROM, RAM, I/O channel interface connector, two 3.5-inch diskette drives, processor, and an LCD.
- 2 Match the optional feature with its description.
  - a. Serial/Parallel adapter
  - b. CRT Display adapter
  - c. Automobile Power adapter

\_\_\_\_\_ This adapter provides power to the system unit and battery when attached to a cigarette lighter outlet

\_\_\_\_\_ This adapter attaches to the back of the system unit, system printer, or another optional feature. It has two functions: to communicate via an RS232C interface, or attach to any device or application that matches its input/output capabilities.

\_\_\_\_\_ This adapter provides the interface required to attach compatible direct drive and composite monitors to the 5140 System Unit
- 3 (True/False) The customer is responsible for installing and setting up the IBM PC Convertible.
4. Which programs are not available with the IBM PC Convertible Model 022?
  - a Exploring, SystemApps, Tools
  - b. SystemApps, Application Selector, Diagnostics
  - c. Application Selector, SystemApps, Tools
  - d Diagnostics, Exploring, Application Selector
  - e Tools

- 5 (True/False) An icon that pictures a “battery” means that the battery is overcharged.
- 6 After powering ON the 5140, and POST runs successfully, \_\_\_\_ beep(s) is (are) heard.
- a 1
  - b 2
  - c 3
  - d 4
- 7 The \_\_\_\_ is responsible for changing the system profile or attaching optional features
- a Service Representative
  - b Marketing Representative
  - c Customer
  - d Systems Engineer

## Study Question Answers:

1.	d
2.	c, a, b
3.	True
4.	c
5.	False. The icon of a battery accompanied with 3 short beeps means that the battery pack needs to be recharged. Review the POST icons table.
6.	2
7.	c



## Session 2: Maintenance

This session requires approximately 0.5 hours to complete

### Introduction

This session will cover the PC Convertible hardware. You will be shown where the internal FRUs are located, including one optional feature. Also, you will see how the external optional features attach to the rear of the system unit.

The *Hardware Maintenance and Service* (HMS) manual will be talked about, and a few of the removals and replacements will be shown. In addition, specific safety precautions for the IBM PC Convertible will be covered.

### Objectives

Upon completion of this session, using the supporting documentation, you should be able to:

1. Locate and identify all FRUs and features called out in the maintenance documentation.
2. Locate the removal and replacement procedures in the HMS, and apply sound safety precautions when servicing the PC Convertible.

### Objective 1 - Locations

Locate and identify all FRUs and features called out in the maintenance documentation

### Highlights

- Internal FRUs/Optional Feature
- External Optional Features

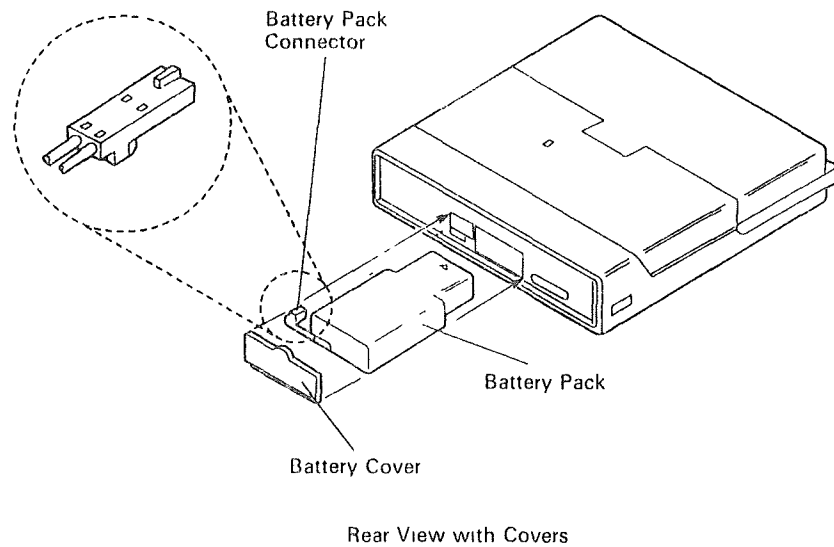
# Activity

## Internal FRUs/Optional Feature

The following pages will help you locate and identify the internal FRUs and the optional feature called out by the PICs

### Battery Pack

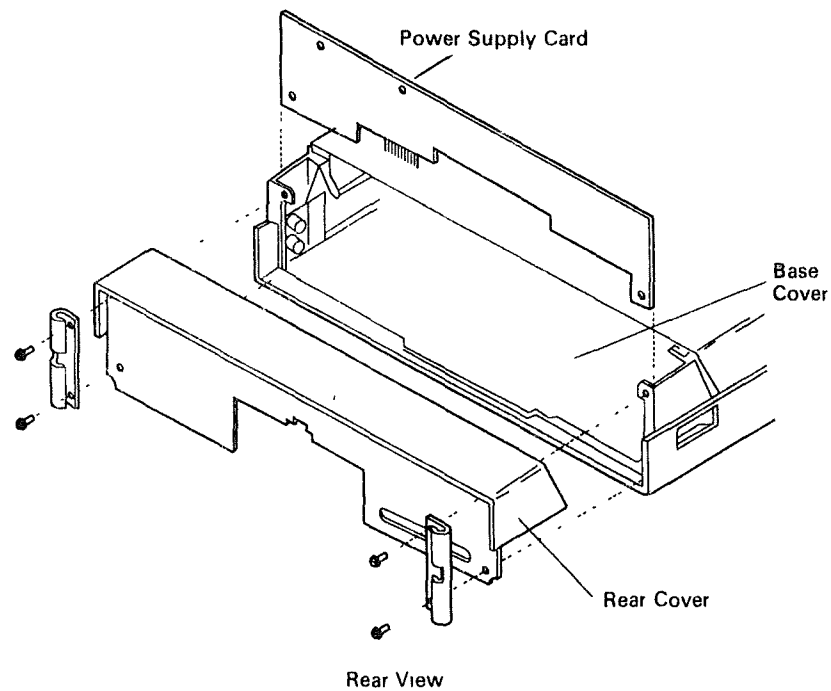
The battery pack is located at the center rear of the 5140 system. A battery cover conceals the battery compartment that the battery pack slides into. A battery pack connector plugs into the power supply card at the same time the battery pack is inserted into the slot



ATL00074

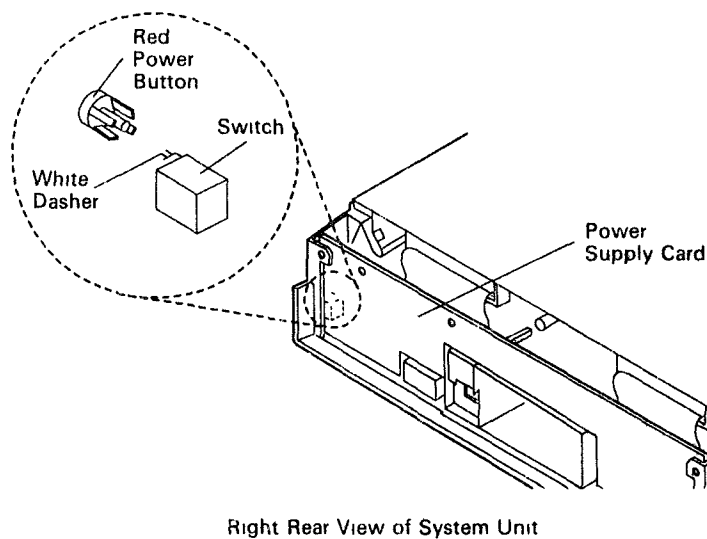
## Power Supply Card

This picture shows the Power Supply Card as it is removed from the rear of the 5140 System Unit. To access this card for voltage measurements or removal, the rear cover needs to be removed. The HMS manual shows the procedure for removing and replacing the power supply card.



ATL00075

When inserting the power supply card, ensure that the white dasher is aligned with the red power button (shown below)

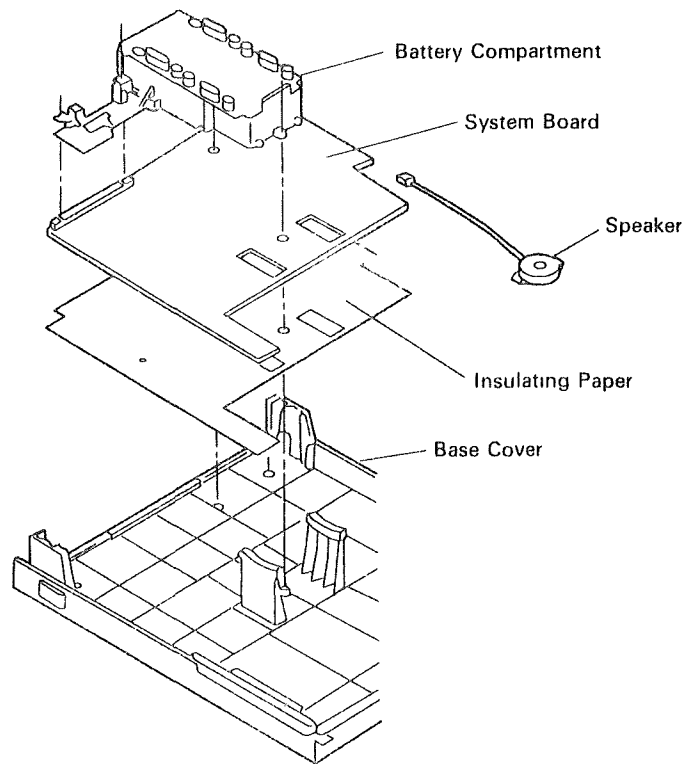


ATL00076

## System Board, Speaker

The system board rests on the insulating paper (shown below) which, in turn, lays on the base cover. If the insulating paper is in any way damaged, remove and replace it. Do not install the new paper over the old paper because the additional thickness will cause the system board to bow and crack.

The speaker is the audio device that “beeps” messages



Side View, Covers Removed

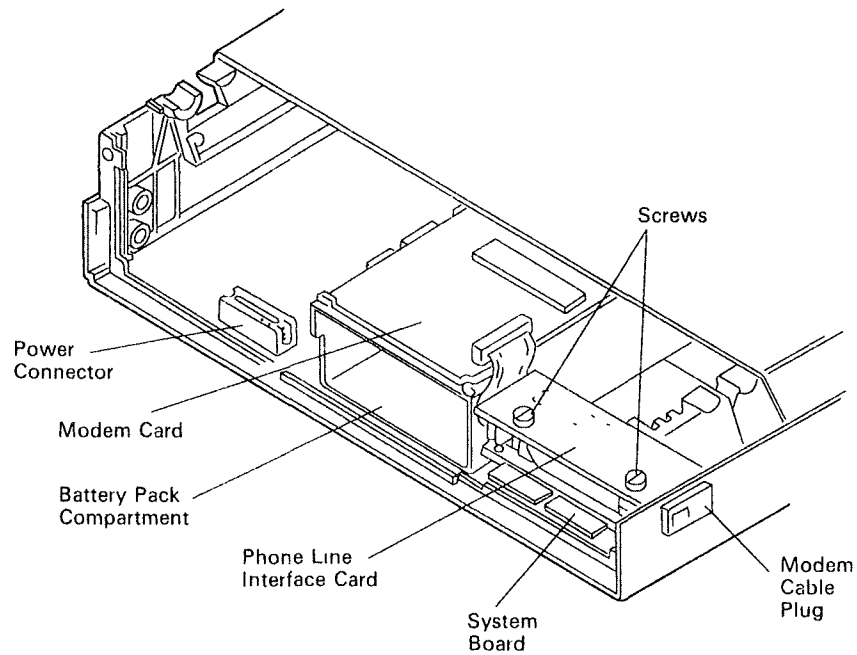
ATL00078



## Internal Modem Feature

The Internal Modem is a feature that resides within the covers of the PC Convertible. This optional feature is one FRU even though it consists of two separate cards, the modem card and the phone line interface card.

The modem card is located directly on top of the battery pack compartment and is attached to the phone line interface card via a cable. The phone line interface card, in turn, is connected to the system board.



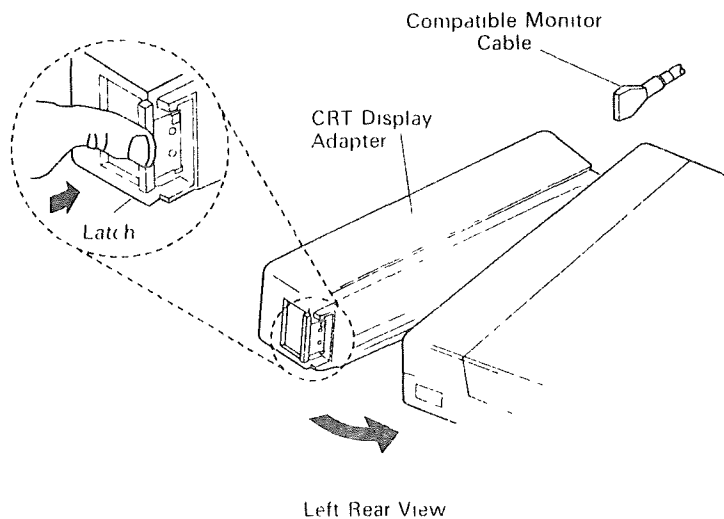
Rear View, Rear Cover Removed

ATL00079

## External Optional Features

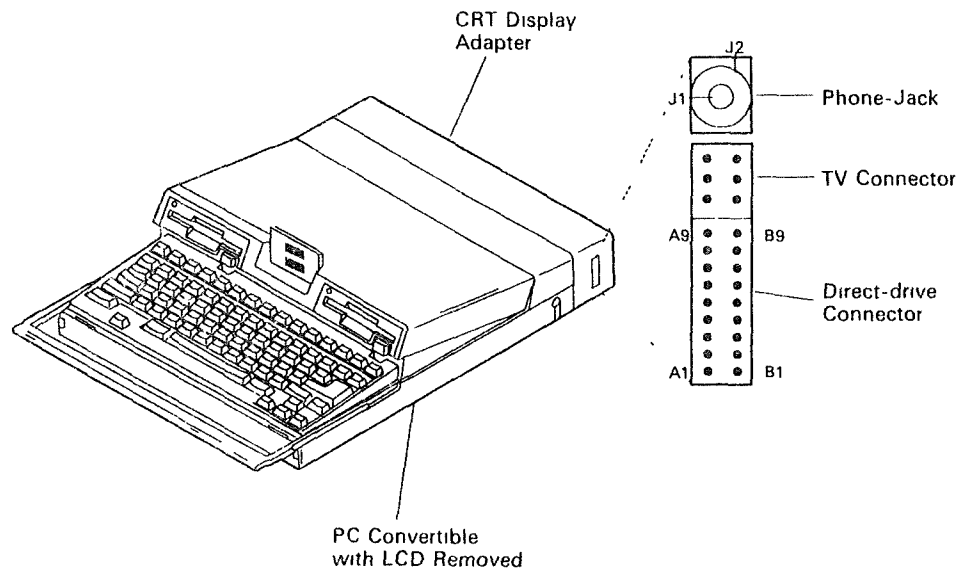
### CRT Display Adapter

The CRT Display adapter attaches to the rear of the PC Convertible as shown below. The front right side of the adapter slides into a notch on the right rear of the system unit. Then the left side of the adapter is pushed forward to allow the 72-pin connector and the I/O channel interface to connect to each other.



AT1 00080

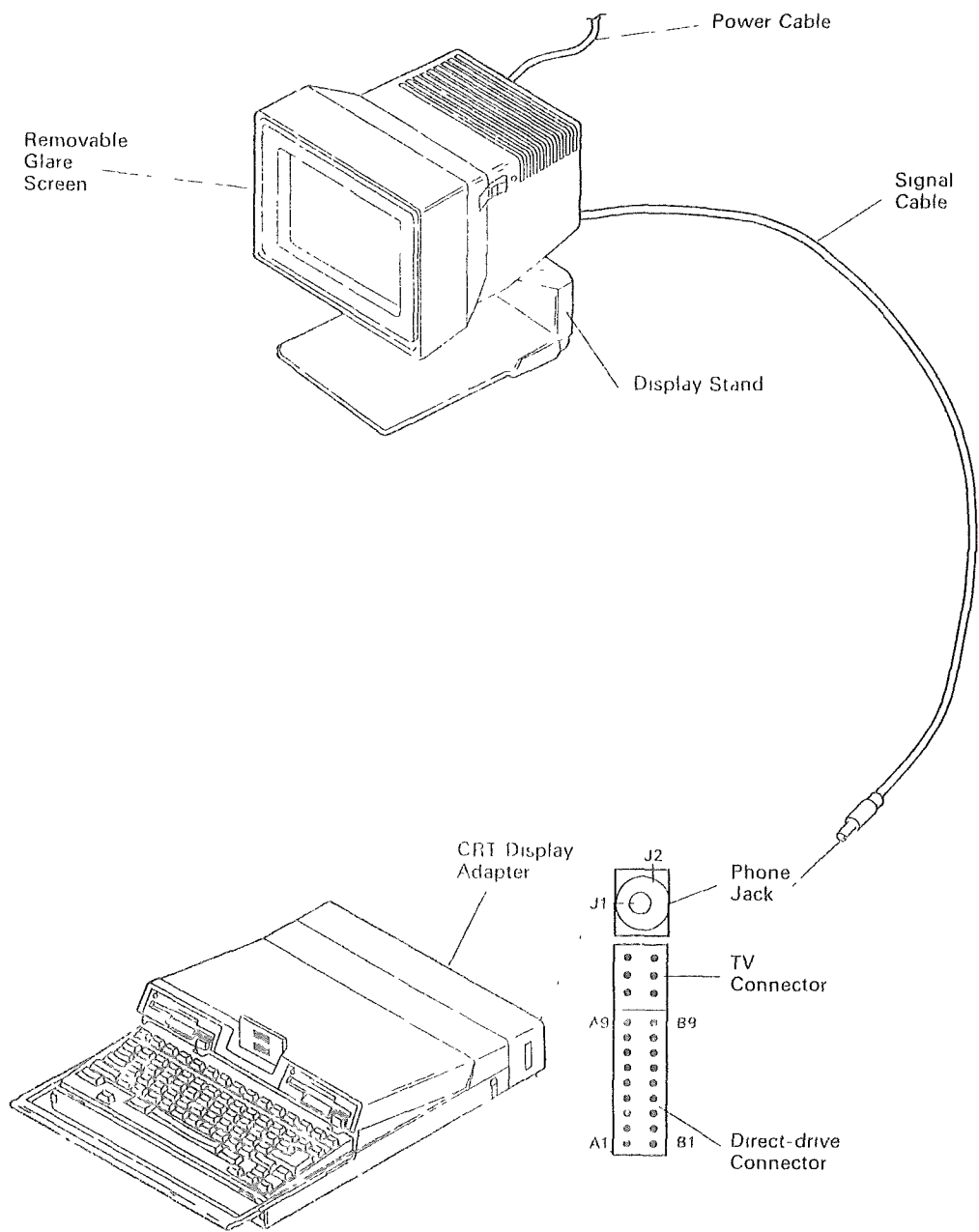
The CRT Display adapter supports both composite and direct-drive monitors via the connector on the right-hand side (shown below). The top part of the connector, called a phone-jack, is the composite video output of the adapter. The middle part is the TV connector which is also a composite video output. And the bottom part, called a direct-drive connector, is the digital video output of the adapter.



ATL00081

5144 Monochrome Display

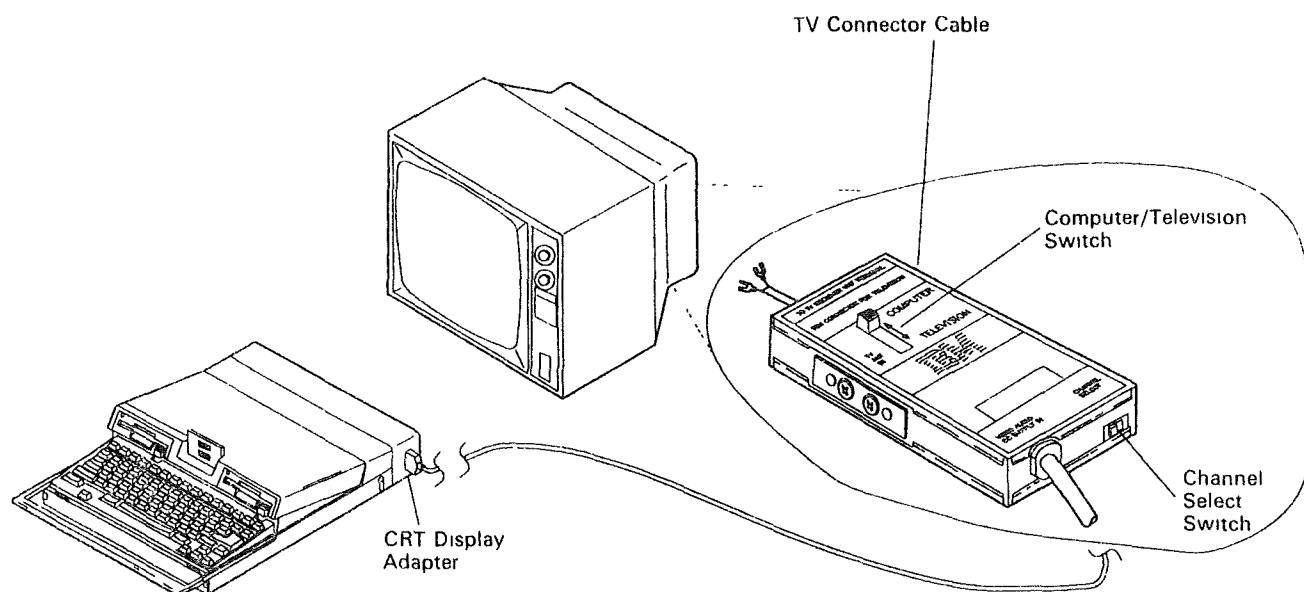
The 5144 Monochrome Display attaches to the CRT Display adapter via a signal cable to the phone-jack part of the connector



ATL00082

## Television Set

A television set can be used as the systems display screen via a Television (TV) Connector Cable. The TV Connector Cable attaches on one end to the television, and on the other end to the CRT Display adapter

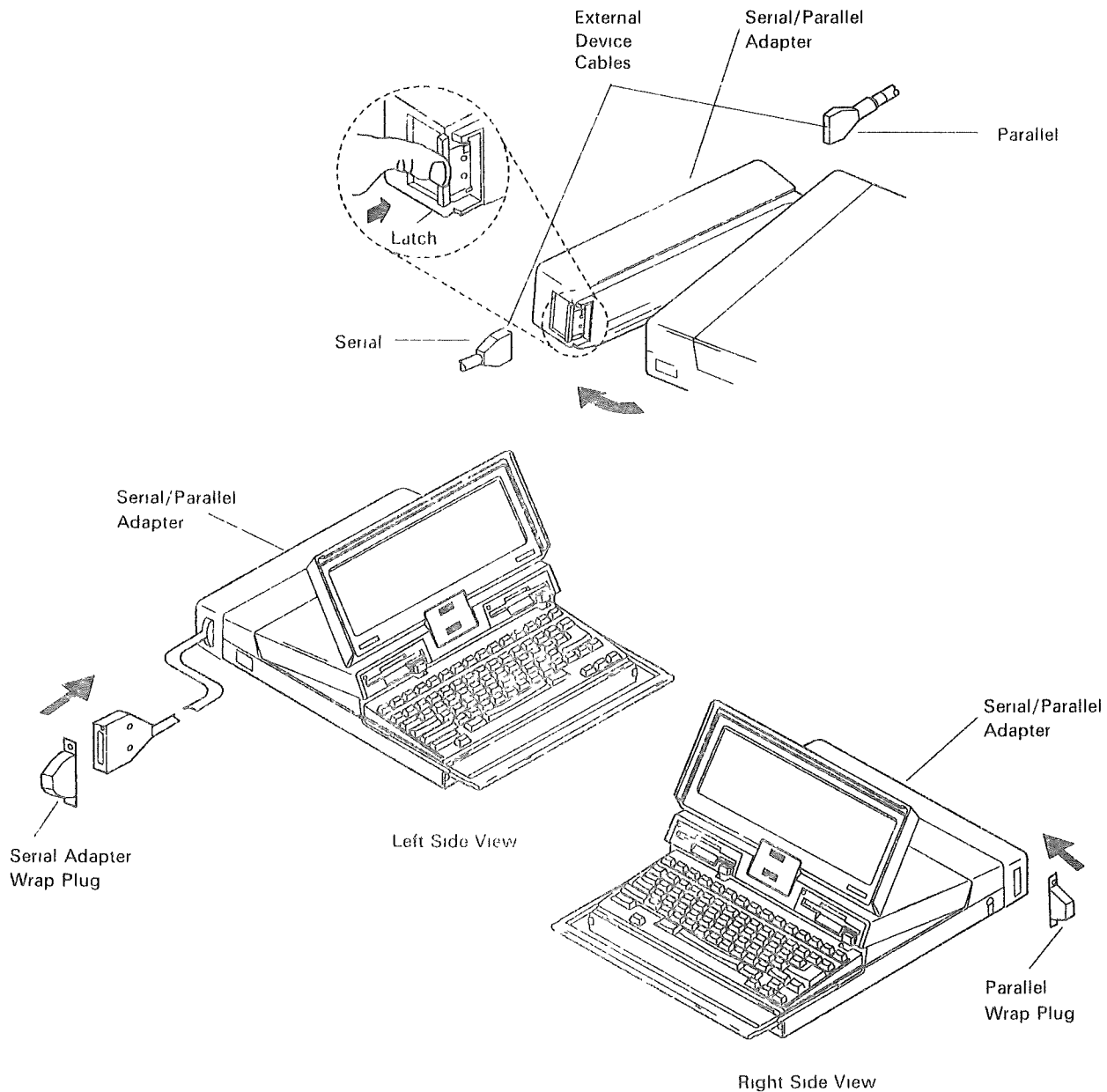


ATL00083

## Serial/Parallel Adapter

The Serial/Parallel adapter also attaches to the rear end of the PC Convertible. The left side of the adapter is the serial side, and the right side is the parallel side (as shown below). Both sides can be used at the same time if the programming will allow it.

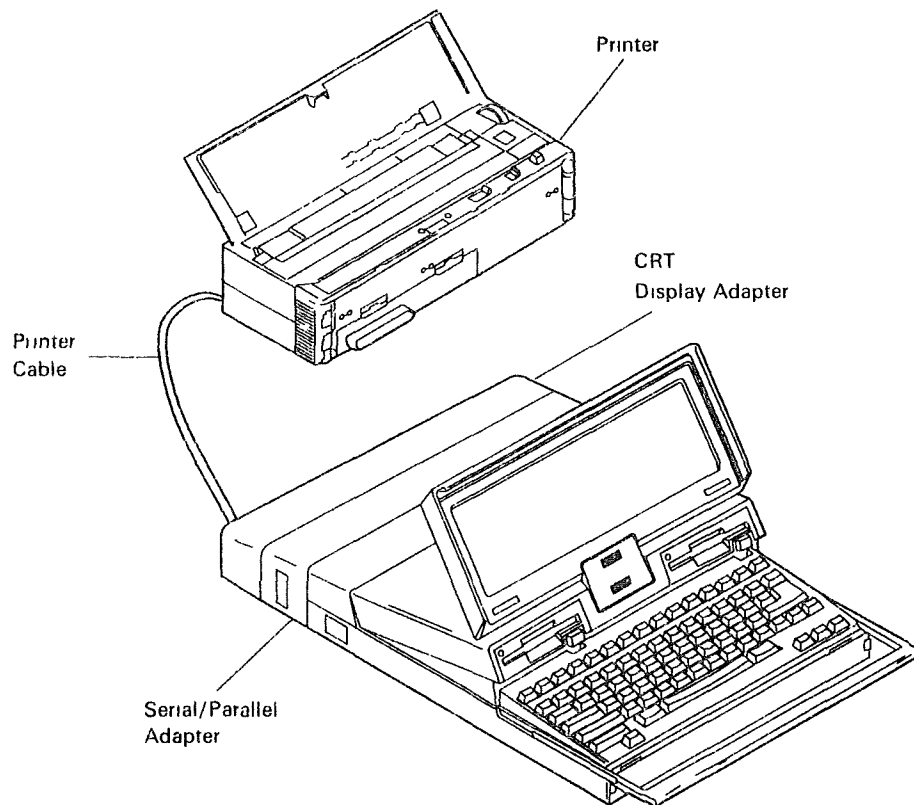
To test the Serial/Parallel adapter, two separate wrap plugs are required. These wrap plugs are the same as used with the 5150, 5160, and 5170 IBM PC systems.



ATL00084

## IBM PC Convertible Printer

The IBM PC Convertible Printer can either be attached directly to the rear of the 5140 System Unit, or via a printer cable.



ATL00085

## Objective 2 - Removals and Replacements

Locate the removal and replacement procedures in the HMS, and apply sound safety precautions when servicing the IBM PC Convertible

### Highlights

- *Hardware, Maintenance and Service* (HMS) manual
- Removals and Replacements
- Safety

### Activity

#### Hardware Maintenance and Service (HMS) manual

Removals and replacements for all FRUs and features can be found in the *Hardware Maintenance and Service* (HMS) manual. The HMS will be shipped to all branch office locations which means that it is not a part of the customer's system ship group.

The HMS is used by trained service personnel to isolate a failing unit and to take the necessary action to make the unit operational. It provides operational instructions and hardware information that is necessary to find the failing part and make the repair.

This manual contains four sections and two appendixes.

- Section 1, "Introduction," describes the system unit and optional features, the service diagnostics, and the items required to service the system.
- Section 2, "Problem Isolation Charts," provides step-by-step procedures for each area of the system to isolate the failing unit. The Problem Isolation Charts (PICs) use a symptom to determine which tests to run and the actions to take to make the unit operational.
- Section 3, "Service Information," provides information on locations, removal and replacements, adjustments, and testing of assemblies, subassemblies, and individual parts of the system.
- Section 4, "Parts Catalog," provides parts lists of assemblies, subassemblies, and individual replaceable parts of the system.
- Appendix A, "POST and Diagnostic Error Codes," provides a list of the error codes and the tests or components that caused the failure.
- Appendix B, "Serial and Parallel Adapter Wrap Jumpers," provides a list of the connector pins that can be jumpered to put the serial adapter and the parallel adapter into wrap mode.



## Removals and Replacements

The following removals and replacements are a few samples pulled from the HMS. They are for training purposes only, so use the HMS to do the actual procedures. The samples included here are:

- Battery Pack 1005\*
- Diskette drives A and B 1020
- Keyboard 1035
- LCD 1040

\* Reference number

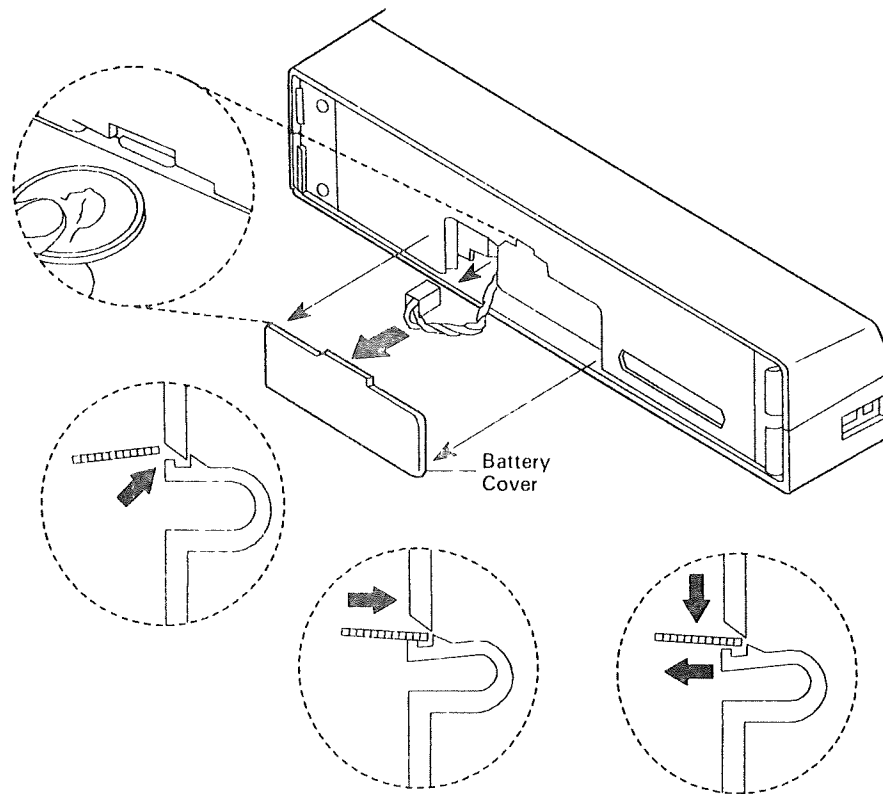
Each procedure is assigned a reference number. If a removal step is described in another procedure, the reference number for that procedure is in parenthesis at the end of the step. For example:

1. Press the system unit power switch off.
2. Remove the AC adapter, automobile power adapter, or battery charger, if attached.
3. Remove any external options.
4. Remove the battery pack (1005).

In the example, step 4 has the reference number 1005, which means the removal procedures for the battery pack are in procedure 1005. Any steps after step 4 are based on the assumption that you have followed the specified procedure.

In addition to showing you how to remove and replace a FRU or option, each procedure contains a test to verify that the system operates correctly after the repair.

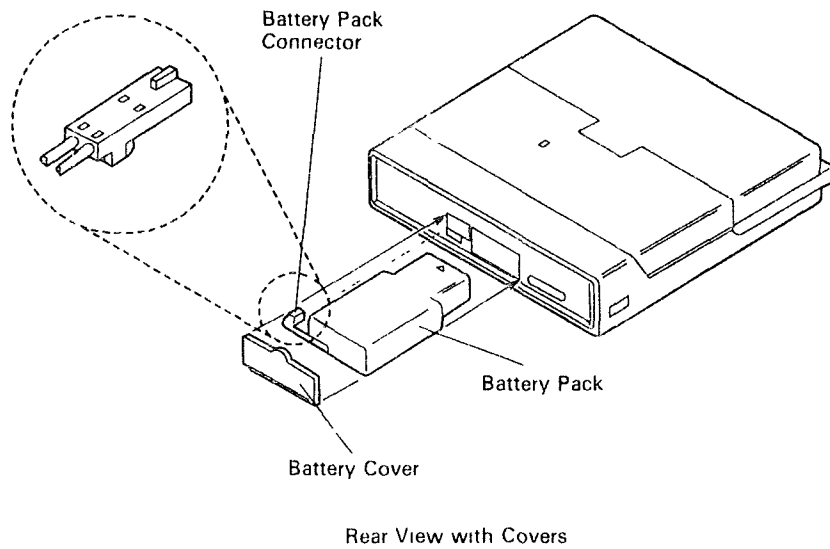
## Battery Pack 1005



ATL00086

### Removal and Replacement

- 1 Press the system unit power switch off.
- 2 Remove the AC adapter, automobile power adapter, or battery charger, if attached.
- 3 Remove any external options
- 4 Insert a coin into the slot on top of the battery cover, and press down to remove the battery cover.



ATL00074

5. Disconnect the battery pack connector by pressing the tab on the bottom of the connector and pulling it straight out
6. Slide the battery pack out of the system unit

**DANGER**

**DISPOSE OF THE BATTERY PACK  
IN THE TRASH. DO NOT DISPOSE  
IN AN OPEN FIRE, BECAUSE THE  
BATTERY PACK MAY EXPLODE.**

To replace the battery pack, reverse the above steps

## **Charging the Battery Pack**

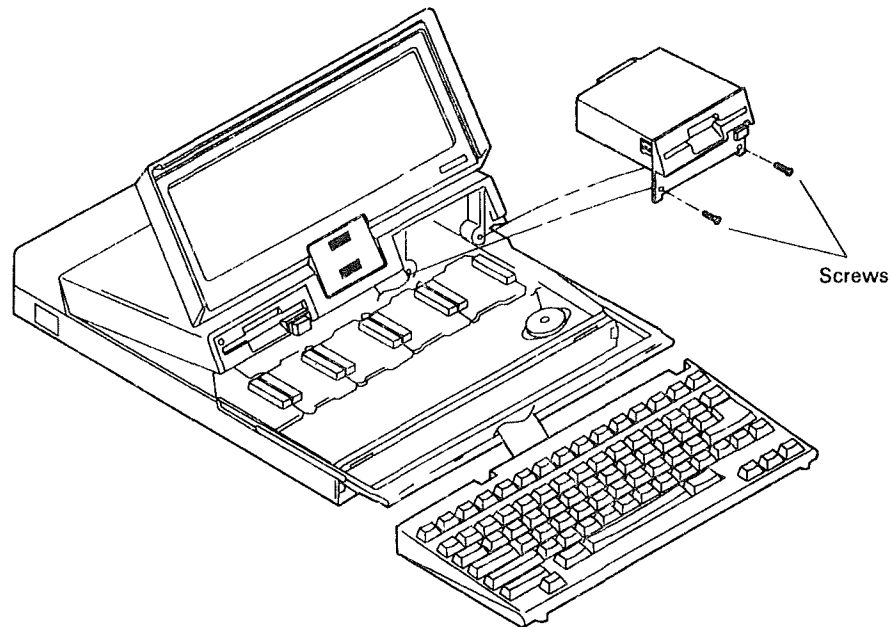
- 1 If removed, install the battery pack into the system unit
- 2 Connect the AC adapter or the battery charger to the system unit.
- 3 Connect the AC adapter or the battery charger into a functional electrical outlet

*Note* It takes about 24 hours to fully charge the battery pack.

## **Test**

- 1 Press the system unit power switch on and wait about 10 seconds.
- 2 Verify that the POST ran correctly. If the AC adapter or automobile power adapter is attached, verify that the low-battery indicator does not display on the LCD after the battery has been charged.

## Diskette Drives A and B 1020

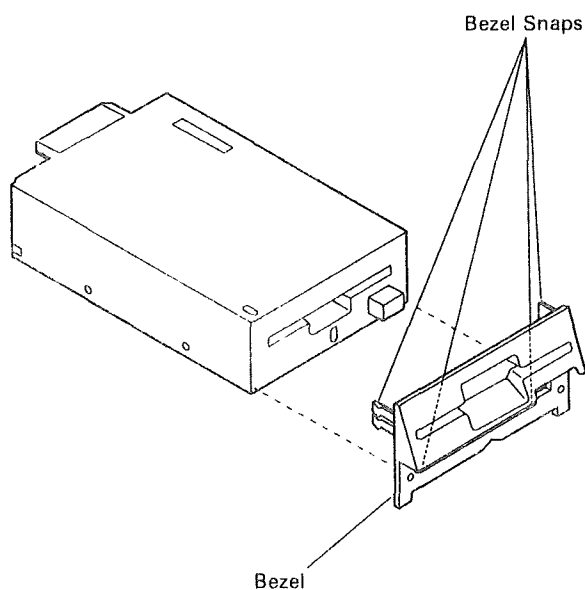


ATL00087

### Removal and Replacement

1. Press the system unit power switch off
2. Remove the AC adapter, automobile power adapter, or battery charger, if attached.
3. Remove any external options.
4. Remove the battery pack (1005).
5. Remove the keyboard (1035)

- 6 Remove the two diskette drive-mounting screws
- 7 Slide the diskette drive out. The diskette drive will be tight until it becomes disconnected from the diskette drive cable



ATL00051

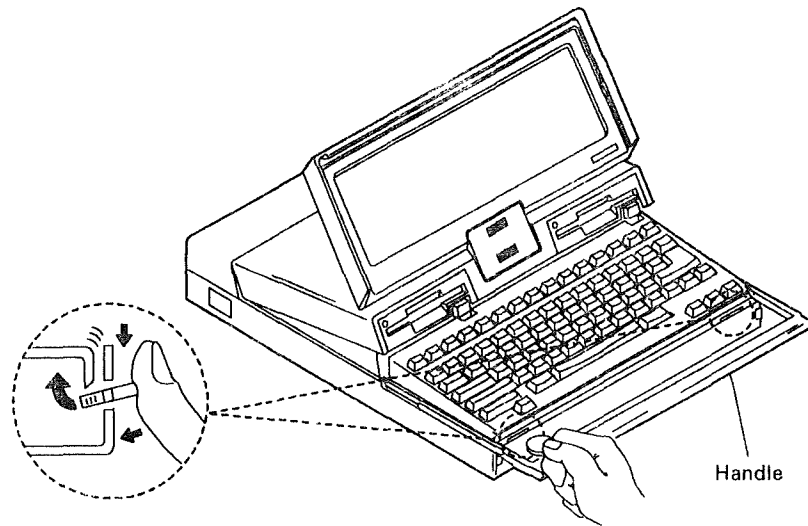
- 8 Gently press out the four snaps to release the bezel.
- 9 Remove the bezel

To replace the diskette drive, reverse the above steps

#### Test

- 1 Press the system unit power switch on and wait about 10 seconds
2. Verify that the POST ran correctly.
3. Load and run the Advanced Diagnostics for the diskette drives

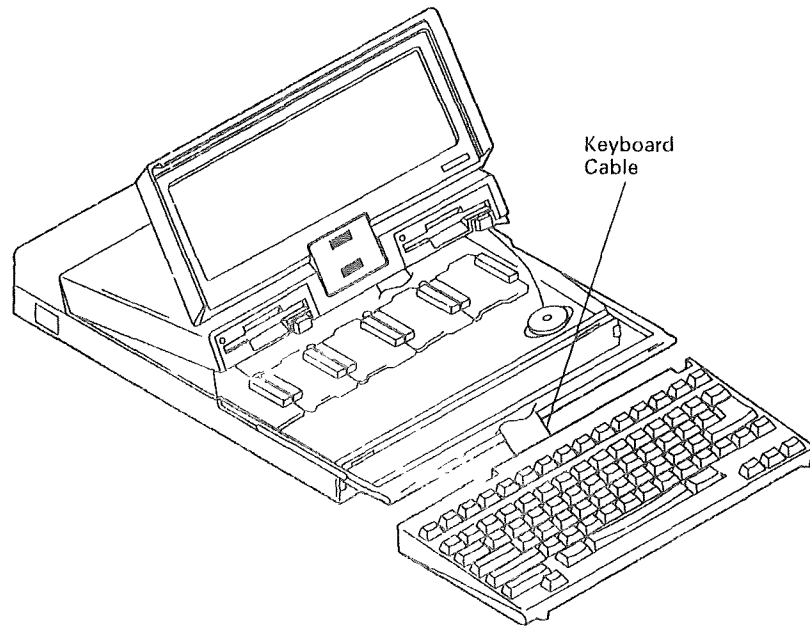
## Keyboard 1035



ATL00088

### Removal and Replacement

1. Press the system unit power switch off.
2. Remove the AC adapter, automobile power adapter, or battery charger, if attached.
3. Remove any external options.
4. Remove the battery pack (1005).
5. Extend the handle.
6. Insert a coin in the slots and press down.



ATL00089

- 7 Gently lift up and remove the keyboard
- 8 Disconnect the keyboard cable from the system board

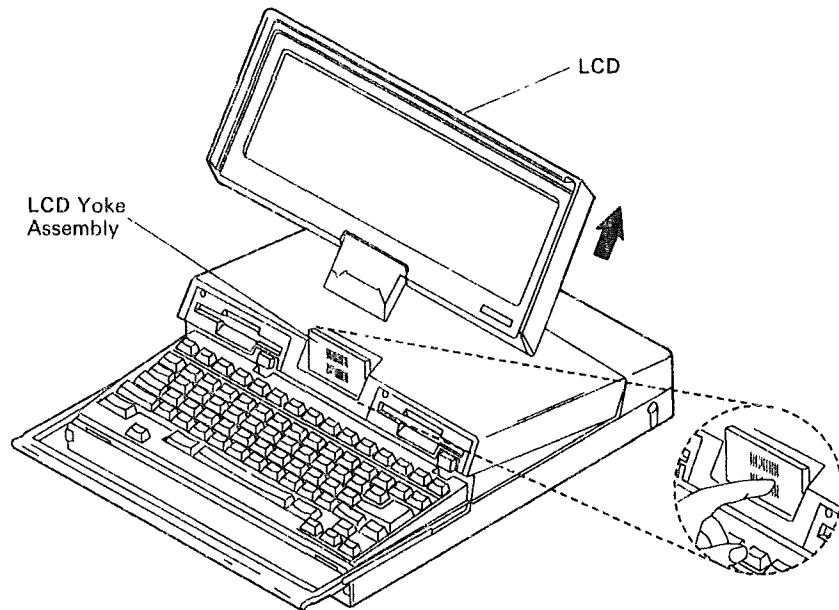
To replace the keyboard, reverse the above steps

### Test

1. Press the system unit power switch on and wait about 10 seconds
2. Verify that the POST ran correctly
- 3 Load and run the Advanced Diagnostics for the keyboard



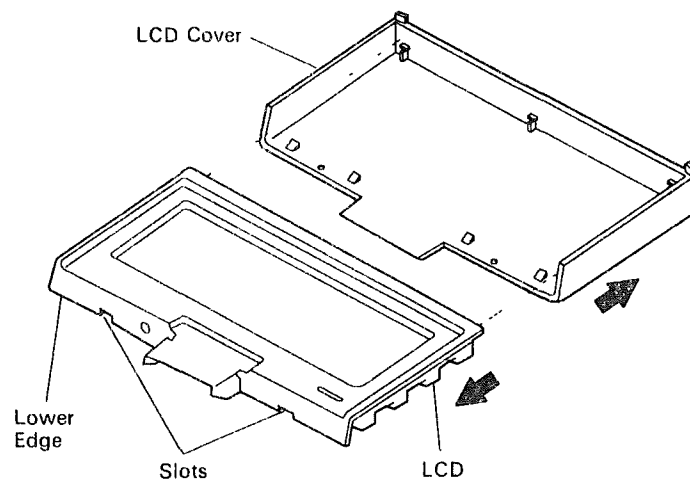
## Liquid Crystal Display (LCD) 1040



ATL00090

### Removal and Replacement

1. Press the system unit power switch off
2. Remove the AC adapter, automobile power adapter, or battery charger, if attached.
3. Press in on the bottom of the LCD yoke.
4. Remove the LCD



ATL00091

- 5 Push screwdriver into slots to separate the lower edge of the LCD cover from the LCD
- 6 Slide the LCD cover and LCD apart

**DANGER**  
**DISPOSE OF THE LCD IN THE TRASH. IF THE LCD IS BROKEN, WEAR RUBBER GLOVES TO WIPE ANY LIQUID WITH A WET CLOTH. DISPOSE OF ANY BROKEN GLASS AND THE WET CLOTH IN THE TRASH. WASH THE GLOVES WITH SOAP AND WATER.**

To replace the LCD, reverse the above steps

#### **Test**

- 1 Press the system unit power switch on and wait about 10 seconds
- 2 Verify that the POST ran correctly
- 3 Load and run the Advanced Diagnostics for the LCD

## Safety

### Safety Inspection Guide

The “Safety Inspection Guide” is located at the beginning of the HMS. It reads:

This inspection guide can assist you in identifying potentially unsafe conditions on this product. Each machine is designed and built with safety items installed to protect users and service personnel from injury. This guide addresses only those items. However, you should use good judgment to identify conditions not covered by this inspection guide.

If any unsafe conditions are present, you should determine how serious the apparent hazard could be and whether you should continue without first correcting the problem.

Consider these conditions and the safety hazards they present:

- Electrical hazards, especially primary power. Primary voltage can cause serious or fatal electrical shock.
- Explosive hazards. A bulging capacitor can cause serious injury.
- Mechanical hazards. Loose or missing hardware can cause serious injury.

The guide goes on to list a series of steps to check the system before servicing it.

## Safety Notes

Below is a listing of the **DANGER** notes and where they are located. Be aware of them when servicing the 5140 System Unit.

Note	Service Unit(s)
<b>DANGER</b> Dispose of the battery pack in the trash. Do not dispose in an open fire, because the battery pack may explode.	Battery pack
<b>DANGER</b> Hazardous voltages may be on the internal modem card and the modem cable if the modem cable is not disconnected in the following order. A potential shock hazard exists.  1. Disconnect the modem cable from the telephone wall outlet.  2. Disconnect the modem cable from the system unit.	Covers  Internal modem  LCD yoke asm  Power supply card  System board
<b>DANGER</b> Dispose of the LCD in the trash. If the LCD is broken, wear rubber gloves to wipe any liquid with a wet cloth. Dispose of any broken glass and the wet cloth in the trash. Wash the gloves with soap and water.	LCD

## Study Questions

1. (True/False) The battery pack, which is a standard FRU, is located directly underneath the keyboard.
2. Put the following FRUs into one of two categories:
  - a. Externally attached
  - b. Internally installed
  - \_\_\_ Serial/Parallel adapter
  - \_\_\_ RAM
  - \_\_\_ Modem
  - \_\_\_ CRT Display adapter
  - \_\_\_ AC adapter
3. Which of the following devices can **NOT** be connected to the CRT Display adapter?
  - a. 5144 Monochrome Monitor
  - b. PC Convertible Printer
  - c. Television set
  - d. 5153 Color Display
  - e. Both b and c
4. The \_\_\_ is used as a guide to removing and replacing defective FRUs.
5. (True/False) Section 3, "Service Information," in the HMS provides information on locations, removal and replacements, adjustments, and testing of assemblies, subassemblies, and individual parts of the system
6. Put the following items into two categories
  - a. General Safety
  - b. PC Convertible Safety
  - \_\_\_ Power cord is frayed
  - \_\_\_ System board looks burned
  - \_\_\_ Battery pack is disposed of in the trash
  - \_\_\_ Internal Modem card/cable is disconnected from telephone wall outlet first
  - \_\_\_ When the LCD is broken, rubber gloves are worn to wipe any liquid with a wet cloth.

## Study Questions Answers:

1. False. The battery pack is located in the center rear of the system in the battery compartment.
2. a, b, b, a, a
3. b
4. HMS
5. True
6. a, a, b, b, b

## **Unit 2: Diagnostic Strategies and Procedures**

### **Session 1: Maintenance Strategies**

This session requires approximately 0.3 hours to complete.

#### **Introduction**

This session will cover two service strategies that a customer will use when a failure on the PC Convertible is encountered. Service Offerings and Customer Problem Analysis and Repair (CPAR).

An understanding of the customer's maintenance plans and procedures gives the service representative a basis from which to draw when discussing a PC Convertible problem with the customer.

#### **Objectives**

Upon completion of this session, using supporting documentation, you should be able to:

1. Understand the service offerings provided by IBM and Authorized Dealers.
2. Discuss the CPAR strategy with the customer if necessary.

#### **Objective 1 - Service Offerings**

Understand the service offerings provided by IBM and Authorized Dealers

#### **Highlights**

- IBM NSD
- IBM Authorized Dealers

## Activity

### IBM NSD

The Primary Warranty and Post-Warranty service offering for the PC Convertible is Customer Carry-In Repair (CCR). The primary offerings for the 5144 monitor is Customer Carry-In Exchange (CCE). These offerings are administered by the NSD Service/Exchange Centers (S/ECs).

NSD is also offering IBM On-Site Repair (IOR) for the 5140 as a warranty upgrade and as a Maintenance Agreement (MA) option. For the 5144 Monochrome Display, IBM On-site Exchange (IOE) is an option for warranty upgrade or MA.

### IBM Authorized Dealers

IBM Authorized Dealers are required to provide Carry-In Repair Service during warranty and are reimbursed by IBM for this warranty offering. For post-warranty, the Dealers are free to service the machines using their own offerings, terms and conditions, and prices.

The standard IBM Dealer Service Option (DSO) is available to IBM Authorized Dealers. The program is administered in essentially the same way as the standard warranty for the 5140 and 5144.

*Note.* These offerings are the same as for other IBM PC products.



**Service Offerings Table**

Service by	Warranty	Post-Warranty MA
<b>IBM</b> • Time period • Service Offering  • Administered by	One year 5140 5140 CCR/IOR* 5144 5144 CCE/COE/IOE* NSD	Annual  CCR/IOR  CCE/COE/IOE NSD
<b>Authorized Dealer</b> • Time period • Service Offering  • Administered by	One year** 5140 CCR  5144 CCE Dealer	TBD 5140/5144 Dealer's Plan or IBM DSO  Dealer

\* Warranty upgrade

\*\* Required and Reimbursed by IBM

**Key:**

CCR - Customer Carry-in Repair  
CCE - Customer Carry-In Exchange  
COE - Customer On-site Exchange  
DSO - Dealer Service Option  
IOE - IBM On-site Exchange  
IOR - IBM On-site Repair  
MA - Maintenance Agreement  
NSD - National Service Division  
TBD - To Be Determined (by Dealer)

## Objective 2 - Customer Problem Analysis and Repair (CPAR)

Discuss the CPAR strategy with the customer if necessary

### Highlights

- CPAR strategy
- Customer steps

### Activity

#### CPAR Strategy

The CPAR strategy has the customer isolate the failing customer replaceable unit (CRU) by following the Problem Determination Procedures (PDPs) in the *Guide to Operations* (GTO) manual. These procedures are designed for easy isolation of single solid faults. This strategy is also used by other PC products

#### Customer Steps

There are three steps the customer follows that lead to the repair of the failing unit. In order, they are:

1. Determine defective CRU
2. Take CRU to be repaired/replaced
3. Reconnect good CRU.

#### Step 1 - Determine defective CRU

First, the customer needs to determine which CRU is defective by running POST and the PDPs. POST will beep and display an icon on the screen if it finds the problem. If POST indicates that all is well, then the PDPs are run.

The PDPs walk the customer through testing the system unit and have them answer questions to help determine the defective CRU. (The customer PDPs will be discussed further in the next session.) If the PDPs find the problem, then Step 2 is performed.

## Step 2 - Take CRU to be repaired/replaced.

After determining the problem, the customer will take the failing CRU to be repaired or replaced. Before this can be done, the CRU needs to be disconnected from other attached devices. For instance, if the system unit is the failing CRU, the customer would disconnect any optional features such as the IBM 5144 Monochrome Display.

*Note.* The IBM PC Convertible Printer does not have a serial number. Consequently, if a problem exists with the printer, both the printer and the system unit will have to be taken to the repair facility.

Next, the customer determines whether IBM NSD or an Authorized Dealer will service the unit. In either case, the appropriate servicer needs to be notified (again, by the customer). IBM is notified by calling the Service Exchange Communication Center (S/ECC). The Authorized Dealer is notified by calling the dealer where the 5140 System Unit was purchased.

With the CRU disconnected, and the place of repair already determined, the customer is ready to take the failing CRU to the servicer. After the repaired or replaced CRU has been reclaimed, Step 3 can then be performed.

## Step 3 - Reconnect good CRU

Finally, the good CRU is to be reconnected with its previously attached devices. As in the earlier example, the IBM 5144 Monochrome Display will be reconnected to the system unit. After reconnecting the good CRU, POST and diagnostic tests are run to ensure that the system is working properly. (Diagnostic tests will be discussed in the next session.)

The following table recaps the preceding steps on how the customer will analyze a problem on the PC Convertible and how to have the CRU repaired.

Customer Problem Analysis and Repair (CPAR) Strategy

Steps	Customer Action
Step 1 Determine defective CRU	– Run POST and PDPs
Step 2 Take CRU to be repaired or replaced	– Disconnect failing CRU. – Call IBM or Dealer to make service arrangements. – Take CRU to NSD or dealer.
Step 3 Reconnect good CRU	– Reconnect good CRU – Run POST and diagnostic test to ensure proper operation

## Study Questions

- 1 (True/False) The primary warranty period for the PC Convertible is one year and is Customer Carry-in Repair (CCR) service. The customer may purchase the IBM On-site Repair option to enhance the warranty service already provided.
- 2 As part of the CPAR strategy which of the following are the correct steps a customer will take when a failure occurs on the IBM PC Convertible?
  - a The customer calls IBM NSD or the Dealer, the service representative returns the customer's call; the servicer diagnoses and repairs the 5140 System Unit
  - b The customer performs the PDPs to isolate the failing CRU, the customer calls IBM NSD or the Dealer for service, the service representative brings the good CRU for the customer to install
  - c The customer calls IBM NSD or the Dealer for help with running the PDPs; the service representative brings a good CRU, the customer installs the good CRU
  - d The customer performs the PDPs to isolate the failing CRU, the defective CRU is taken to be repaired by the appropriate servicer (after a call to the S/ECC or Dealer has been placed); the customer reinstalls/reconnects the good CRU

## Study Question Answers:

1. True
2. d

## Session 2: Customer Maintenance Package

This session requires approximately 0.7 hours to complete.

### Introduction

The customer maintenance package, used to isolate the failing CRU, consists of the Power-On Self-Tests (POST), the Problem Determination Procedures (PDPs) and the customer diagnostic diskette. The PDPs and the customer diagnostic diskette are located in the PC Convertible GTO which is part of the documentation shipped with each machine.

You will learn that POST should always be run first. Through audio and visual responses (beeps and icons) the user can tell if POST has completed successfully or not. If it was successful, then the diagnostic PDPs are performed; if it was not successful, then the POST Symptom/Fix Table will help locate the failing unit. In either case, the POST PDPs direct the customer where to go and what to do.

The intent of this session is to familiarize the service representative with the customer's problem determination responsibilities. Then when a call is placed by a customer, the service representative should expect that both the POST and Diagnostic PDPs have been performed and the results can be discussed.

### Objectives

Upon completion of this session, using supporting documentation, you should be able to:

- Question the customer on the results of POST
- Question the customer on the results of the diagnostic tests

### Objective 1 - PDP/POST

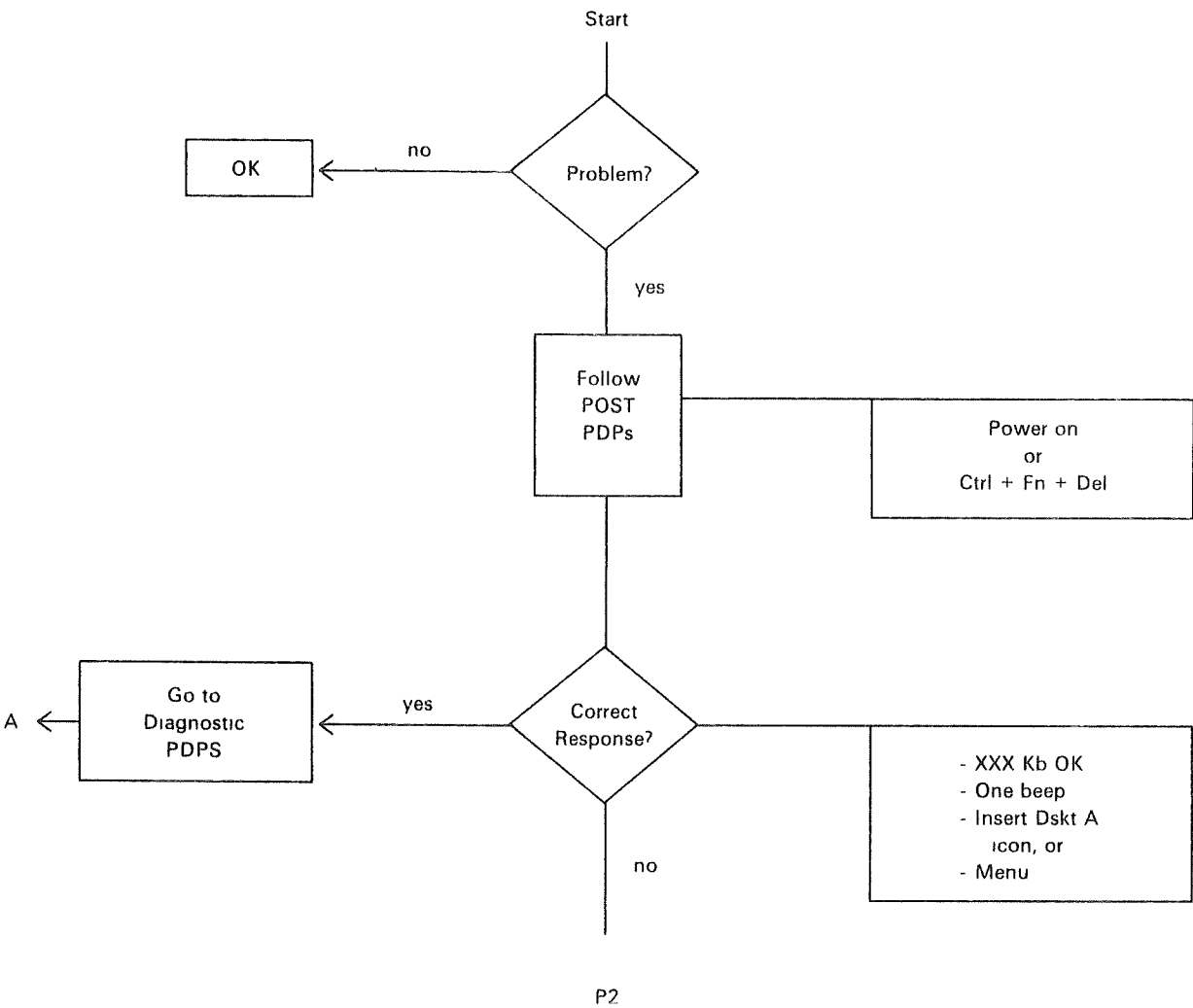
Question the customer on the results of POST.

### Highlights

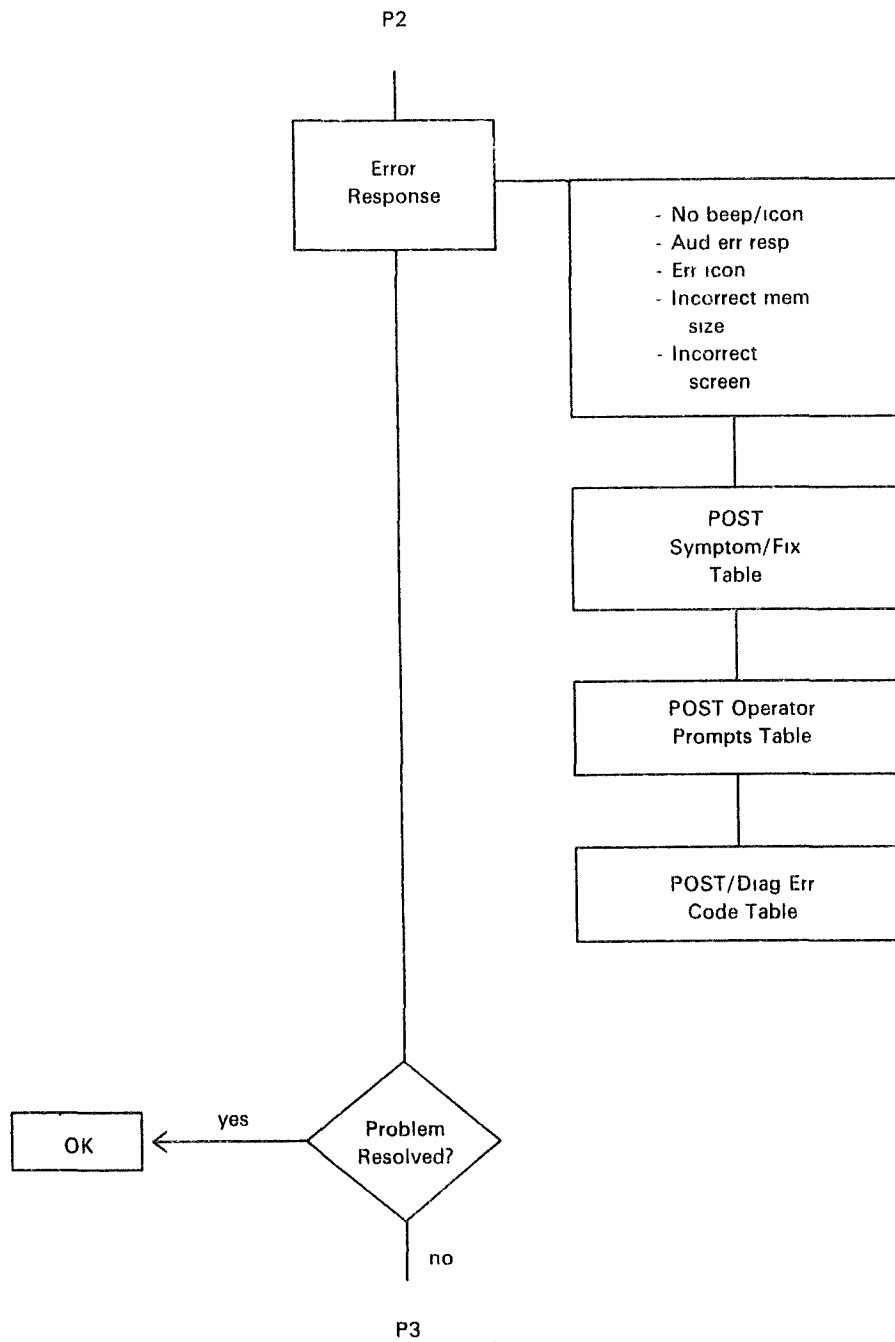
- PDP Flowchart
- POST PDP - Part 1
- POST Correct Responses - Part 2
- POST Error Responses - Part 3

# Problem Determination Flowchart

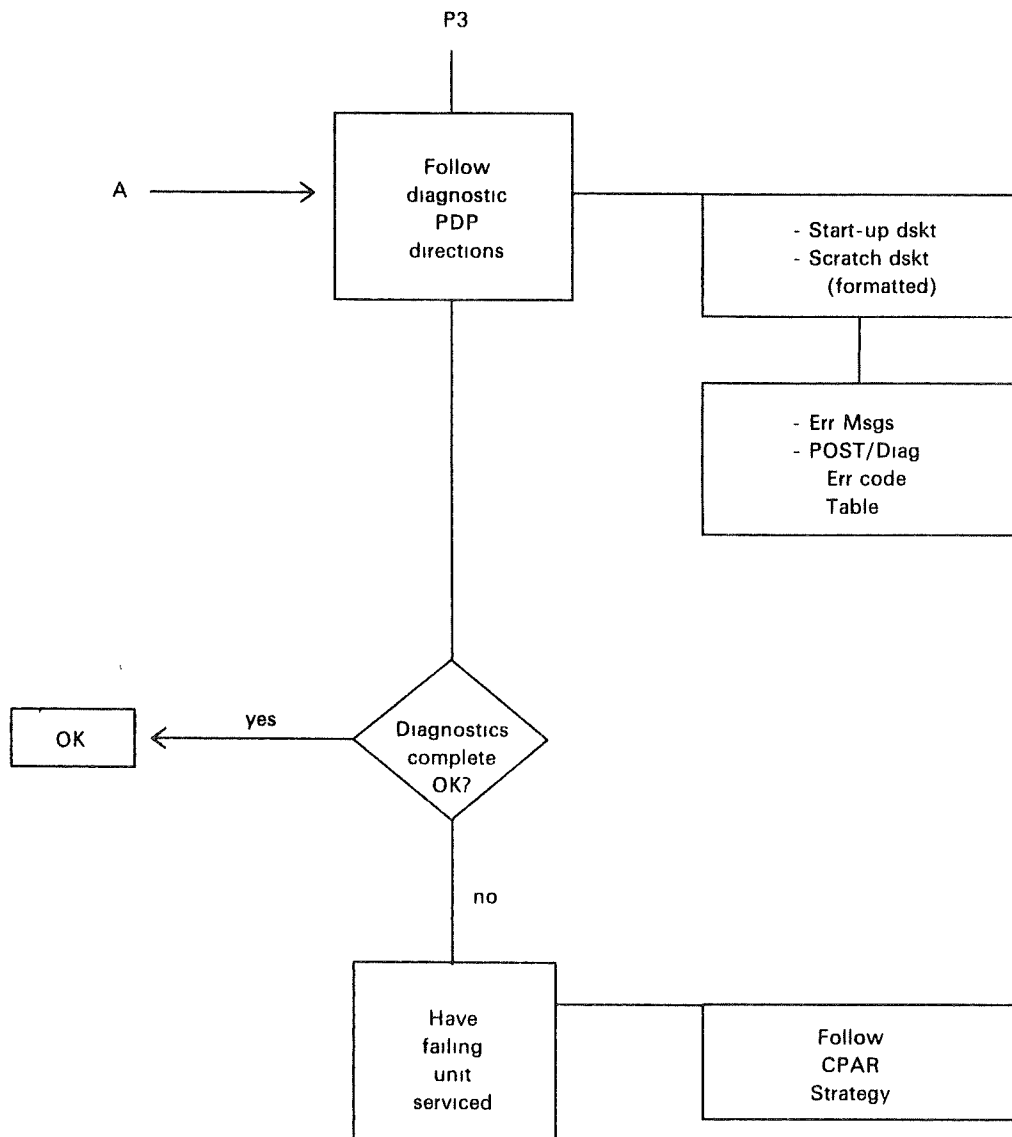
Study the following flowchart to see how problem determination works for the customer. The pages following the chart will be split into four parts and explained separately in more detail. Not all decisions will be discussed, only the major ones.



ATL00162



ATL00163



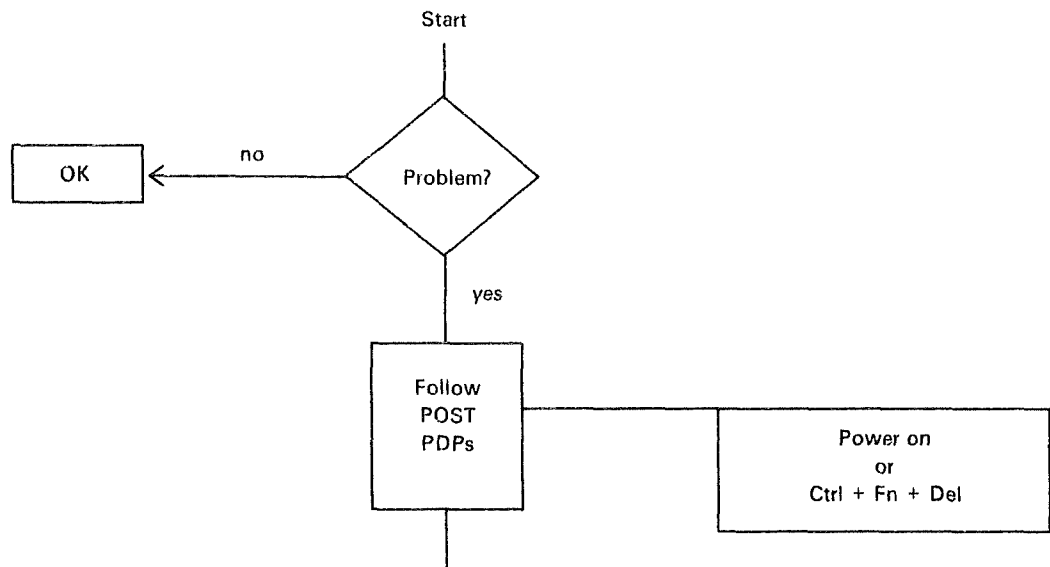
ATL00165



## Post PDP - Flowchart Part 1

POST resides in read-only memory (ROM) and is invoked by powering on the system unit or by simultaneously pressing the Ctrl + Fn + Del keys. Consequently, POST is run automatically every time the system is turned on or reset.

POST tests the system unit logic, memory, and the feature interfaces that are on the system board. If no failure is detected, the correct memory size is displayed and one beep is sounded. But if a failure is detected, then the customer will follow the POST Problem Determination Procedures (PDPs).



ATL00166

To begin Problem Determination, the customer will go to Section 7 of the GTO and start following the POST PDPs. However, before starting POST, there are two messages to read: a warning and a note.

The warning warns the user that data in memory will be altered by POST, and to save any data that is being used before running POST (no matter whether the Power-On Option equals Resume or IPL). The reason for this is that POST asks the customer to Ctrl + Fn + Del, which clears all data in memory. This is how it reads:

**Warning:** The POST alters the data in memory. Before starting the POST, you should save on diskette, any data that is in system memory.

The note explains that an AC adapter must be powering the system unit if an LCD is not attached. This is just a reminder that if the CRT Display adapter along with one of the optional display features is installed, it is necessary to have the system unit powered by the AC adapter. The note reads:

*Note.* If you do not have an LCD attached, the AC adapter must be connected to the system unit.

After reading the warning and note messages, and saving any data that needs saving, the customer then follows the PDP steps

## **Starting POST**

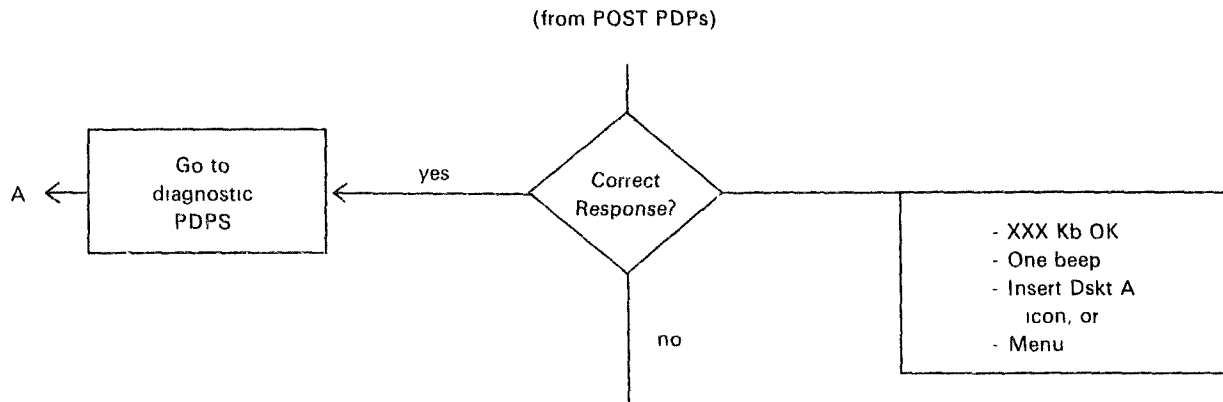
The POST checks the base system and adapters. The POST starts and runs

- When the power button is pressed to power-on the system
- When the Ctrl + Fn + Del keys are simultaneously pressed to reset the system

When the system is powered on with “Power-on option = Resume,” the POST validates the first 128Kb of memory and tests the system board and the system adapters. The data in memory is not altered; when the POST completes, the application can be continued where it left off

When the system is powered on with “Power-on option = IPL,” or the system is reset by pressing Ctrl + Fn + Del, the POST tests all of memory and the system board and the system adapters. Running the POST in this manner clears data in memory. Any data that is in system memory should be saved on diskette before the system is powered off or before the Ctrl + Fn + Del keys are pressed to start the POST

## POST Correct Responses - Flowchart Part 2



ATL00168

After pressing the Ctrl + Fn + Del keys to reset the system, the POST completes correctly if the following sequence occurs:

1. A XXX Kb OK message displays. The memory tested increases in 64Kb increments until it equals the memory installed in the system.
2. The system beeps once.
3. One of the following displays:
  - The Insert Diskette A icon displays, if there is no system diskette in drive A.
  - The appropriate menu displays, if there is a system diskette in drive A.

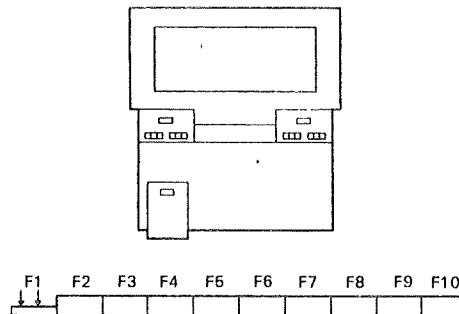
For example, the POST PDPs will, at one point, ask.

Did the sequence of [correct] responses occur? (If you are not sure, repeat the steps to run the POST again.)

**YES**                    Go to “Diagnostic Problem Determination Procedure on pages 7-17.

**NO**                    Go to “POST Symptom/Fix Table” on pages 7-11.

If the correct responses occur, you will answer YES if the following icon appears on your screen and the 5140 beeps once.



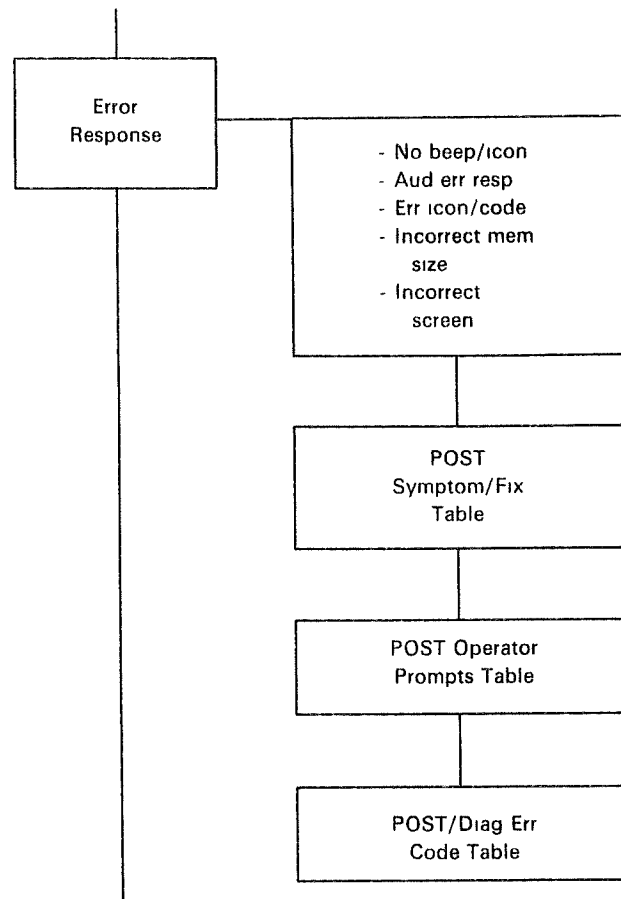
ATL00092

Since the correct responses did occur, then you will continue to the diagnostic PDPs in order to test the system more in depth. They will be discussed in the next assignment.

If you receive an error response, you will answer NO and go to the POST Symptom/Fix Table. Error responses and the Error Responses table will be explained next.

## POST Error Responses - Flowchart Part 3

(from POST Correct Responses)



ATL00164

If the POST detects an error, the test stops and one or more of the following indications will occur:

- No audio or visual response (the system does not beep and the screen remains blank)
- An audio error response (the system beeps more than once)
- An error icon (may include an XXXX error code)
- An incorrect memory size
- An incorrect screen (such as no cursor, incorrect characters, or unstable characters).

For instance, suppose you press the power button on the 5140 System Unit and you do not hear any beeps or see any icons or a menu. You will answer NO to the POST PDP question (used in the previous example) and go to the POST Symptom/Fix Table

Did the sequence of [correct] responses occur? (If you are not sure, repeat the steps to run the POST again )


YES Go to “Diagnostic Problem Determination Procedure” on pages 7-17

NO Go to “POST Symptom/Fix Table” on page 7-11

*Note* The above referenced page numbers are for training purposes only Refer to the maintenance documentation when servicing a machine

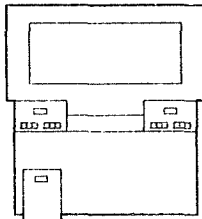

**POST Symptom/Fix Table**

The POST Symptom/Fix Table is one of three tables that the customer will use to determine a suspected problem with the system unit. (The other two will be discussed in the order shown on the flowchart ) As in the example above, the customer will find the table in the GTO and look for their problem A sample of the chart is shown below.

Symptom	Fix
No power indication	Go to “Power Problem Determination Procedure” on page 7-36.
Three short beeps or low battery icon 	Recharge the battery pack  If the same symptom occurs, replace the battery pack Refer to “Battery Pack” on page 1-2.  If you continue to have this problem, have the system unit and the AC adapter, automobile power adapter, or battery charger serviced.

## POST Operator Prompts Table

The POST Operator Prompts Table shows and explains the warning and operator prompt icons. This table is used after receiving an error icon on the screen when POST is run. The format of the table looks like this

ICON	Meaning/Action
<p>Insert Diskette A</p> 	<p>An indication that there is no system diskette in drive A</p> <p>If a broken diskette occurs with this icon, it indicates a diskette read failure.</p> <p>If a RESUME (017X) error occurs with this icon, it indicates that the system was unable to resume the application that was suspended.</p> <p>Insert the PC Convertible Start-up diskette or a system diskette in drive A, and press the F1 key to continue</p> <p>If the problem continues, have the system unit serviced.</p>
<p>Low battery</p> 	<p>The battery is too low to operate the system. However, the system can be operated using the AC adapter or automobile power adapter.</p> <p>Recharge the battery pack</p>

The Insert Diskette A icon is a familiar one. There are four possible meanings for it, and one action to be taken

Meaning	Action
• No diskette in drive A	
• Read failure	
• Unable to resume	Insert Dskt, F1 F
• Service system unit	

## POST and Diagnostic Error Codes

This table is called POST and Diagnostic Error Codes. It is used when POST or the diagnostic tests return an error code on the screen. An error code is four digits and is signified by an "XXXX" in the PDPs. Of course, the XXXX will be replaced with a valid error code of the system component that caused it.

Let's say you just received a CRT Display adapter and a Monochrome Display feature to attach to the PC Convertible. If you power off the system and install the adapter and display you will receive an error code of 0174. Looking at the POST and diagnostic Error Code Table (below) you will realize why the error code has occurred and update the System Profile.

Error codes 0170, 0172, and 0174 are not hardware errors, but they are Resume errors. The GTO states that "when the CRT Display Adapter is attached, you cannot use Power-on Option = Resume." Changing the System Profile to Power-on Option = IPL will correct the problem.

Error Code	Component
0170	The LCD was not active when the system was powered off (The application cannot be resumed when using the CRT Display adapter )
0172	The diskette drive was active when the system was powered off
0174	The LCD configuration was changed The CRT Display adapter was added after the system was powered off
01XX	System board
02XX	Memory card
03XX	Keyboard
05XX	CRT Display adapter
06XX	Diskette drive
09XX	Serial/Parallel adapter-parallel port
11XX	Internal modem or Serial/parallel adapter-serial port
12XX	Serial/Parallel adapter-serial port
14XX	Matrix/graphics printer
50XX	Liquid crystal display (LCD)
51XX	Portable printer

*Note.* The XX can be any number



## Objective 2 - PDP/Diagnostic Tests

Question the customer on the results of the Diagnostic tests.

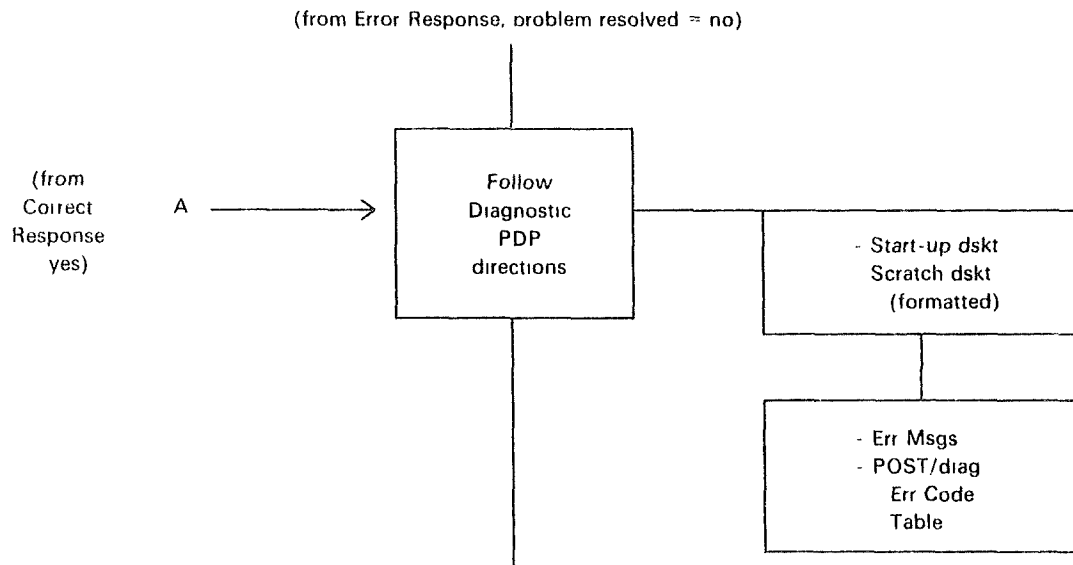
### Highlights

- Diagnostic PDP - Flowchart Part 4

### Activity

The customer level diagnostics reside on the PC Convertible Start-up diskette and test the 80C88 microprocessor, real time clock, memory, and the installed I/O devices. The tests are linked together so they run as one, making it easy to use. Text messages on the display inform the customer of test results. Instructions for running the tests are fully described in the PDP section of the GTO

#### Diagnostic PDP - Flowchart Part 4



ATL00167

To run the diagnostics, the customer will need the PC Convertible Start-up diskette and a formatted (scratch) diskette. The Start-up diskette, which includes the diagnostics, is used to run the diagnostic testing program; the formatted scratch diskette is used to test the diskette drives

The PDPs will step the customer through the actual running of the diagnostics. For this course it is not necessary to follow the procedures, but to know that they exist. One item that you will need to know, though, is about Error Messages

## **Error Messages**

If a failure occurs when the diagnostics are run, an error message displays. The customer is instructed to make a note of the message, including the error code, and take it with the failing unit when it is serviced.

Let's say that the customer received this message while running Diagnostics.

```
ERROR - SYSTEM UNIT 0151  
RECORD THE ERROR CODE AND  
HAVE YOUR SYSTEM UNIT SERVICED
```

The first line is the failing unit and the error code. The rest of the message tells the customer what action to take to return the unit to operation.

Reviewing the POST and Diagnostics Error Code table (from the previous assignment), an 01XX error indicates a problem with the System Board. So the customer will write down the error code, remove all attached devices from the system unit, and hand both items over to their servicer (which might be you).

## Study Questions

- 1 To initiate POST.
  - a Press the power button (to turn the system power ON)
  - b Press the F1 key.
  - c Press Ctrl + Fn + Del (to reset the system).
  - d a and c above.
  - e a and b above
- 2 (True/False) Resume is the only "Power-On" option.
3. Put the following POST problem determination steps in the correct sequence
  - \_\_\_ Press Ctrl + Fn + Del and then release the keys.
  - \_\_\_ Save any data that is in the system's memory
  - \_\_\_ Go to "POST Symptom/Fix Table" or "Diagnostic Problem Determination Procedures" in the GTO.
  - \_\_\_ Turn the system power off, remove any diskettes and/or all Non-IBM attachments and cables, and turn the system power on
- 4 (True/False) Before attempting to run the Diagnostic Tests, POST should be run
5. (True/False) The Start-up diskette and a formatted scratch diskette are needed to run the customer level diagnostic tests.

## Study Question Answers:

1. d
2. False. There are two options: Resume and IPL. Resume only checks the first 138Kb of memory, the system board and the system adapters; IPL completely checks the whole system, including all of memory (any data will be lost if it is not properly saved), the system board, and the system adapters.
3. 3, 1, 4, 2
4. True
5. True



## Session 3: Service Maintenance Package

This session requires approximately 1.0 hours to complete.

### Introduction

This session will cover the two parts of the Service Maintenance Package. Service Diagnostics and the Problem Isolation Charts (PICs).

The Service Diagnostics for the IBM PC Convertible consists of POST and the Advanced Diagnostics. The POST and the Advanced Diagnostics are used, along with the HMS manual, to isolate a reported failure and describe the action necessary to return the system to operation.

To test the system, POST and the Advanced Diagnostics should be run. The PICs direct you through running diagnostic tests, taking measurements, and the actions necessary to repair or replace a failing unit. Service Aids (wrap connectors) will also be used to help identify an intermittent system problem. Also discussed in this session is how the environment can, and will, affect the system unit operation.

The Service Diagnostics, PICs, Service Aids and environmental considerations are the servicer's responsibility. The intent of this session is to familiarize you with the PC Convertible Diagnostics and PICs.

### Objectives

Upon completion of this session, using supporting documentation, you should be able to:

- 1 Use the Service Diagnostics to isolate a system failure or to test the IBM PC Convertible for proper operation.
- 2 Use the PICs to isolate a system failure down to the failing FRU. This includes resolving intermittent problems, using wrap connectors, and understanding environmental effects.

# Objective 1 - Service Diagnostics

Use the Service Diagnostics to isolate a system failure or to test the IBM PC Convertible for proper operation

## Highlights

- POST
- Advanced Diagnostics

## Activity

### POST

The POST for the service representative is the same as the POST used by the customer, which resides in ROM. The HMS manual includes many of the same tables as the customer's GTO does, such as.

- POST audio responses
- POST operation
- POST correct responses
- POST error responses
- POST icons

However, the servicer has an additional option to loop POST for troubleshooting intermittent problems. Running the POST more than one time helps to recreate the failure.

To run the POST in loop mode, all diskettes need to be removed from the system drives, the system powered on, and the Ctrl + Fn + Del keys pressed. When the F1 Prompt icon displays (arrows pointing to the F1 key), simultaneously press the Ctrl and L keys. The POST will run continuously until an error occurs or until it is stopped by powering the system unit off.

Directions on how to loop POST can be found in the HMS manual under intermittent problem determination.

### Advanced Diagnostics

The Advanced Diagnostics are located on the IBM PC Convertible Advanced Diagnostic Diskette and are used with the Problem Isolation Charts (PICs). You can select and run the tests individually or in combination with others, or you can run all the tests together. The requirements or set-up instructions to run the tests are described in the PIC for the device being tested.

To completely test the 5140 system, you must run the Power-On Self Test (POST) before running the Advanced Diagnostics.

To run the Advanced Diagnostics you insert the Advanced Diagnostic diskette into drive A, simultaneously press then release the Ctrl + Fn + Del keys, and follow the instructions on each menu to select and run the tests.

There are many different menus, but the five that you will see the most are:

- Advanced Diagnostics Menu
- Installed Devices Menu
- System Checkout Menu
- Test Selection Menu
- Log Utilities Menu

### **Advanced Diagnostics Menu**

This is the first menu displayed

The IBM PC Convertible  
Advanced Diagnostics  
Version X XX  
(C) Copyright IBM Corp. 1986

Select an option

0 - Run Diagnostic Routines  
1 - Format Diskette  
2 - Copy Diskette  
4 - Set System Profile  
9 - Exit to system diskette

Enter the action desired  
?

## Installed Devices Menu

This menu displays all of the devices and options that the Diagnostics 'device presence test' senses are installed

The Installed Devices are

- 1 - System Board
- 2 - 256Kb Memory
- 3 - Keyboard
- 50 - Liquid Crystal Display
- 5 - CRT Display Adapter
- 6 - 2 Diskette Drives
- 9 - Serial/Parallel Adapter
  - Parallel Port
- 11 - Internal Modem
- 12 - Serial/Parallel Adapter
  - Serial Port
- 51 - Portable Printer

Is the memory size correct (Y/N) ?

## System Checkout Menu

This menu allows you to select the number of times to run the tests, use the error log, or end the diagnostics.

System Checkout

- 0 - Run tests one time
- 1 - Run tests multiple times
- 2 - Log Utilities
- 3 - Loop POST/Diagnostics
- 9 - Exit Diagnostic Routines

Enter the action desired

? -



## Test Selection Menu

This menu allows you to select the device or devices to be tested. The corresponding numbers, separated by commas or spaces, are entered at the bottom of the list next to the question mark. To test all the devices, the Enter key is pressed

### Test Selection

- 1 - System Board
- 2 - 256Kb Memory
- 3 - Keyboard
- 50 - Liquid Crystal Display
- 5 - CRT Display Adapter
- 6 - 2 Diskette Drive(s)
- 9 - Serial/Parallel Adapter
  - Parallel Port
- 11 - Internal Modem
- 12 - Serial/Parallel Adapter
  - Serial Port
- 51 - Portable Printer
- 14 - Matrix Printer

Enter the number(s) of options to test  
or press enter to select all options  
?

## Log Utilities Menu

This menu allows you to start, stop, and list the error log and to set and check the time of day.

<p>Log Utilities</p> <p>0 - Start Error Log 1 - Stop Error Log 2 - List Log 3 - Set time of day 4 - Display time of day 5 - Erase Error Log 9 - Return from Utilities</p> <p>Enter the action desired &gt; _</p>
--

The Advanced Diagnostics can be run in normal or loop mode. In normal mode, when a failure is detected the test will stop system operation, and an error indication will be displayed.

In loop mode, when a failure is detected, the test can either be stopped, or logged and continued. The errors are logged on a blank, formatted diskette or printed, depending on the logging device that you select. The loop capabilities are for detection of intermittent failures and for extended testing without user intervention.

## Objective 2 - Problem Isolation Charts (PICs)

Use the PICs to isolate a system failure down to a failing FRU. This includes resolving intermittent problems, using wrap connectors, and understanding environmental effects.

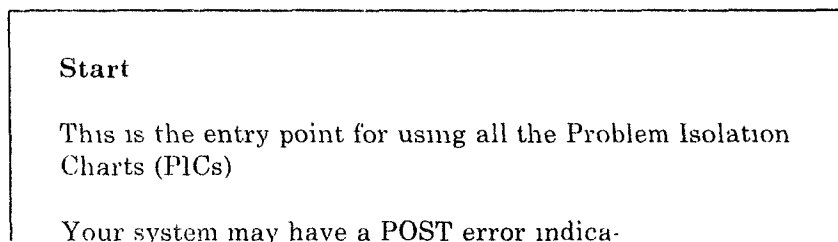
### Highlights

- How to use the PICs
- Start
- Intermittent Problem PIC
- POST Error Indication Chart
- POST Error Code Chart
- Advanced Diagnostic Error Indication Chart
- Service Aids
- Environmental Considerations

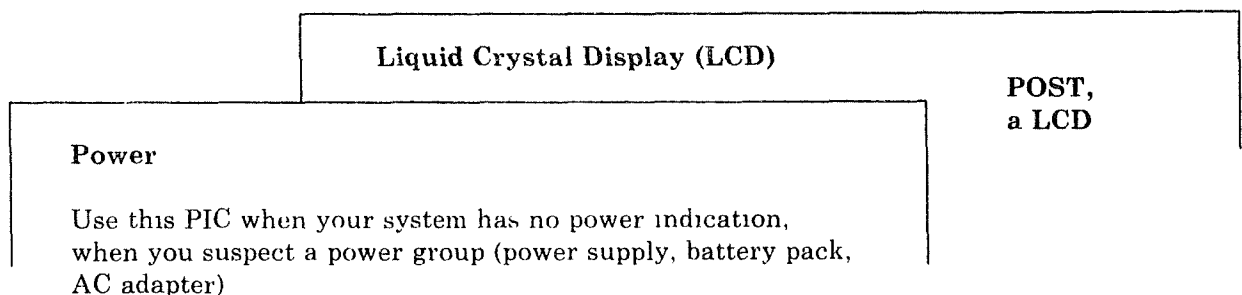
### How to use the PICs

The Problem Isolation Charts (PICs) are located in the HMS manual. They direct you through the tests to run, the measurements to make, and the actions necessary to repair or replace the failing unit.

Always begin with "Start" in the PIC Section 2.



Using error indications, "Start" directs you to the correct PIC.



The PICs will guide you through a series of steps that use the IBM PC Convertible Advanced Diagnostic Diskette to find the failing unit.

The "Service Information" section will guide you to complete the repair. This was covered in the previous session under Maintenance. The PICs include references to the Service Information Section

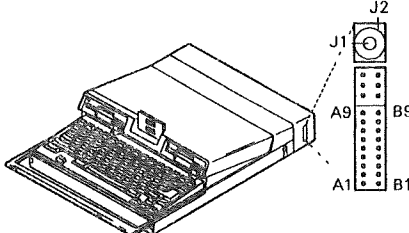
This is an example of a page from the PICs

Steps to take, tests, checks, or observations

Question to be answered YES or NO

Instructions to replace a Field Replaceable Unit (FRU), make adjustment, or go to another page

Measure the voltages at the pins on the CRT-display-adapter direct-drive, and phone-jack connectors as shown in the table below



PIN	PIN(gnd)	MIN volts dc	MAX volts dc
A4	B5	+2.4	+5.5
A5	B5	+2.4	+5.5
A6	B5	+2.4	+5.5
A7	B5	+2.4	+5.5
J1	J2	+1.0	+2.4

ARE ALL THE VOLTAGES WITHIN THE LIMITS SHOWN IN THE TABLE?

NO    Replace the CRT display adapter. Refer to Section 3, "Service Information" on page 3-1

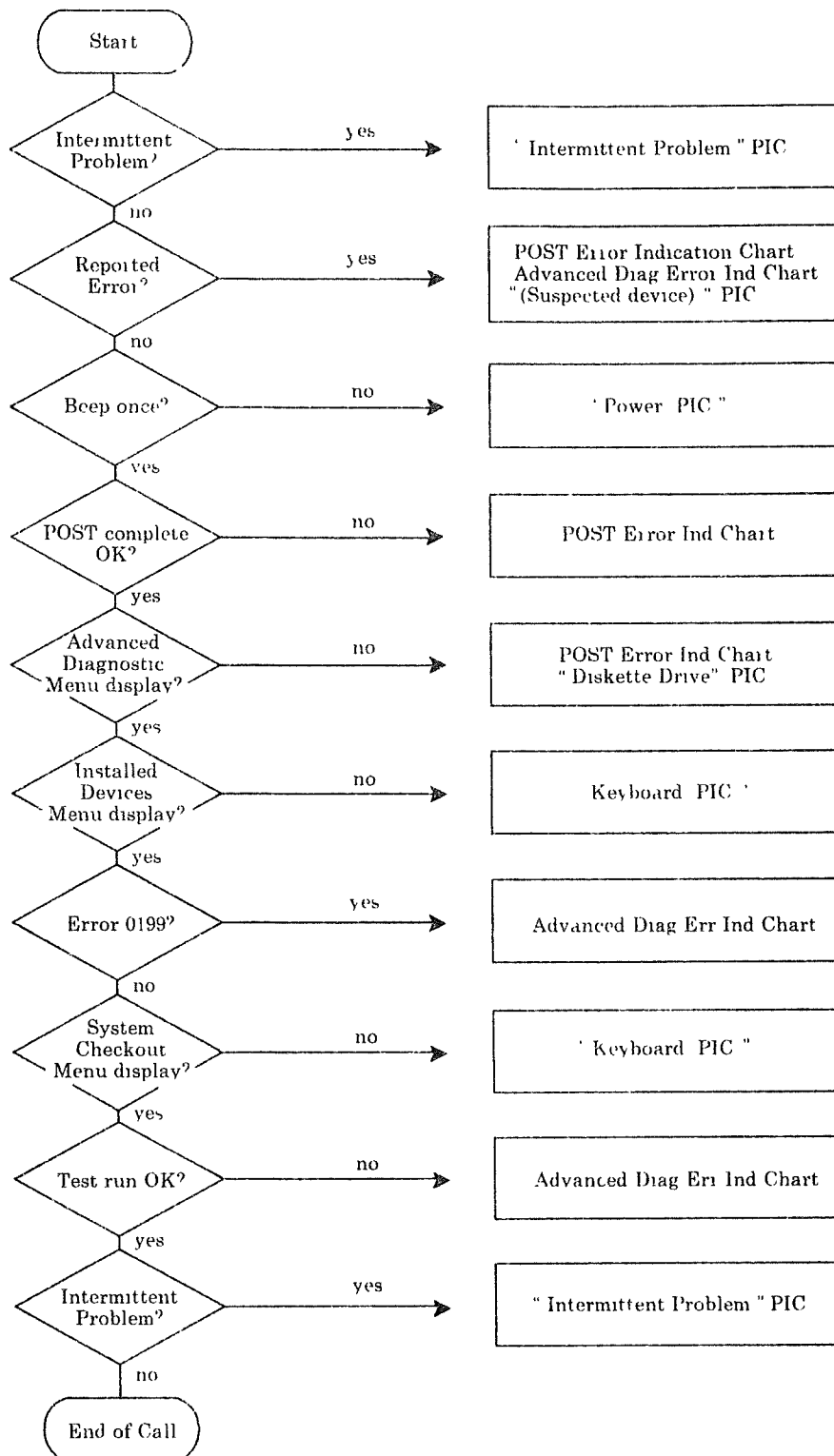
YES    Go to page 2-500-16

2-500-15

ATL00093

## Start PIC

This is the entry point for using all the Problem Isolation Charts (PICs). Each of the FRUs and installed options has its own PIC. The Start PIC guides you to the correct PIC to use. It flows like this:



ATL00170

## Intermittent Problem PIC

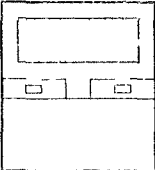
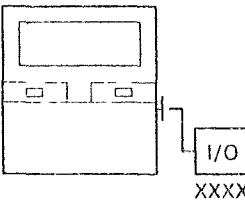
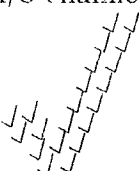
The intermittent problem PIC is used when the POST and the Advanced Diagnostics run correctly or if you suspect an intermittent problem.

If you suspect an intermittent problem you can run the POST and the Advanced Diagnostics more than one time (looping) to try to recreate the failure. This PIC includes:

- |   |   |
|---|---|
| Creating the Error Log                                  | - These steps show you how to create an error log for recording error messages to help you diagnose a failure in a system unit                      |
| Starting the Test<br>(Looping the POST/<br>diagnostics) | - These procedures cause the POST and selected advanced diagnostics to run the number of times you choose   |
| Ending the Test and<br>displaying the Error<br>Log      | - These steps show you how to get to the error log to find out if any errors occurred   |
| Looping POST  | - These steps put the system in loop mode and run the POST continuously<br>Recording error messages to help you diagnose a failure in a system unit |
| Looping the Advanced<br>Diagnostics                     | - These steps run the Advanced Diagnostics multiple times   |

## POST Error Indication Chart

The POST Error Indication Chart shows a list of error indications (icons) and the action to be taken. A sample of this chart is shown below.

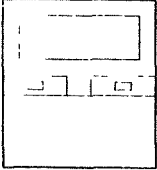
Indication	Action
<p>System unit icon XXX Kb OK</p>  <p>XXXX</p>	<p>Go to "POST error code chart" on page 2-19.</p>
<p>Options icon XXX Kb OK</p>  <p>XXXX</p>	<p>Go to "POST error code chart" on page 2-19.</p> <p><i>Note</i> If error codes are under both icons, start with the first error code under the system unit icon and go to page 2-19.</p>
<p>I/O channel check</p> 	<p>Go to "Power" on page 2-020-1.</p> <p>To restart, press the Ctrl, Fn, and Del keys.</p>

*Note:* The above page references are for training purposes only; refer to the HMS manual for the actual page numbers.

## POST Error Code Chart

If an error code appears under the System Unit icon, use this chart to match the error code with the FRU or Option PIC to use. The following is a sample of the chart.

*Note* The XX can be any number.

Error Code	Action
System unit icon XXX Kb OK  XXXX	
01XX	Go to "System Board" on page 2-100-1
02XX XX	Go to "Memory" on page 2-200-1
03XX	Go to "Keyboard" on page 2-300-1
06XX	Go to "Diskette Drive" on page 2-600-1.
11XX	Go to "Internal Modem" on page 2-1100-1
50XX	Go to "Liquid Crystal Display(LCD)" on page 2-5000-1
51XX	Replace the system board. Refer to Section 3, "Service Information" on page 3-1

Notice that the error code numbers correspond to the Test Selection number. See "Test Selection Menu" on page 91. To run diagnostic tests on the system board, you will press 1. If an error code occurs, it will be an 01XX code. The LCD selection number is 50, the error code numbers are 50XX, and so on. The two Xs following the 02XX code further define a memory problem.

*Note.* The above page references are for training purposes only, refer to the HMS manual for the actual page numbers.



## Advanced Diagnostic Error Indication Chart

If you enter this chart with an Advanced Diagnostic error code, you locate your error code in the chart and go to the PIC indicated in the action column

If you enter this chart with an installed device or option missing from the installed devices list, you use the Device/Option column to locate your missing device or option and go to the PIC indicated in the action column.

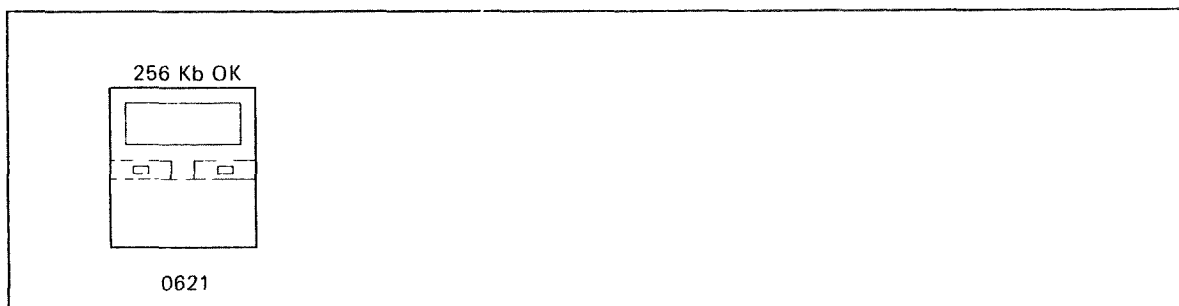
If a system has a known problem on a device, go to the PIC for that device.

*Note* The XX can be any number

Error Code	Device/ Option	Action
01XX	System Board	Go to "System Board" on page 2-100-1  Note A 0199 error message means that you chose N on the INSTALLED DEVICES menu. Do not replace the system board. In this chart, locate the device or option that was missing from the INSTALLED DEVICES menu, and go to the PIC indicated in the action column.
02XX XX 03XX 05XX  06XX	Memory Keyboard CRT Display adapter Diskette Drive	Go to "Memory" on page 2-200-1 Go to "Keyboard" on page 2-300-1 Go to "CRT Display adapter" on page 2-500-1  Go to "Diskette Drive" on page 2-600-1

*Note* The above page references are for training purposes only, refer to the HMS manual for the actual page numbers.

As an example, let's say that you ran the Advanced Diagnostics and received an error code of 0621. On the left side of the screen, you would see the correct memory installed, the System Unit icon and the error code.



Refer to the previous page and you will see that an 06XX error code is a diskette drive problem. You will then go to the Diskette Drive PIC to isolate the problem. An 0621 error code is a seek error. By following the Diskette Drive PIC, you will find that when the drives were swapped, the problem followed the drive. The repair action is to replace the failing diskette drive.

There is a listing of all the error codes in Appendix A "POST and Diagnostic Error Codes" of the HMS manual.

## Service Aids

Two wrap connectors are available as options and are required to isolate the failing FRU within the Serial/Parallel Interface Adapter. One wrap connector plugs into the Serial side, while the other plugs into the Parallel side.

These wrap plugs are the same as used with the 5150, 5160, and 5170 IBM PC systems. The part numbers for the wrap plug assemblies are in the Parts section of the HMS manual.

Servicing the Serial/Parallel adapter does not require purchasing the wrap plugs. Appendix B "Serial and Parallel adapter Wrap Jumpers" shows the pins to jumper to place the serial adapter and the parallel adapter into wrap mode.

## Environmental Considerations

Because the PC Convertible is portable, the environment plays a bigger role in problem determination than for a system that stays in a controlled environment all day. Therefore, take the environment into consideration when diagnosing an intermittent or hard-to-find problem. Here are some things to watch out for.

### System unit

Business executives who travel will probably take the 5140 with them when on a business trip. This could mean hot or cold days, dry or wet days. When temperature changes are drastic, allow the system about 15 to 20 minutes to become adjusted to the change before operating it.

The temperature allowances are: 10.0 to 40.6°C (50 to 105 °F).

The system should not be powered on if condensation has formed on the system unit. Operation may be resumed after the condensation has evaporated.

### Printer Ribbon

At high temperatures, around 35°C (95°F), the printer ribbon may melt. This is because it is a wax-base ribbon. The ribbon can be damaged if exposed to direct sunlight or high heat. This may also show up as an intermittent print quality problem.

### Thermal Paper

Thermal paper requires special handling because it has been specially processed. Printed thermal paper should be stored out of direct light, either sunlight or fluorescent, and should not be stored with the printed surfaces together, as the printed images might transfer. Storage of this paper in high heat can cause paper darkening and print fading.

### Diskettes

Keep diskettes away from extreme heat and cold. The recommended temperature range is 10-60°C (50-140°F).

# Study Questions

- 1 The two types of service diagnostics are \_\_\_\_\_ and the Advanced Diagnostics
- 2 (True/False) The Advanced Diagnostics can be run alone or in conjunction with the PICs
- 3 Match the following menus with their appropriate description.
  - a Advanced diagnostics menu
  - b Installed devices menu
  - c System checkout menu
  - d Test selection menu
  - e Log Utilities

\_\_\_\_ This menu allows you to select the number of times to run the tests, use the error log, or end the diagnostics

\_\_\_\_ This menu allows you to start, stop, and list the systems errors and to set and check the time of day

\_\_\_\_ This menu allows you to select the devices to be checked out.

\_\_\_\_ This menu is the first menu displayed.

\_\_\_\_ This menu displays all of the devices and options that the diagnostics 'device presence test' senses are installed
- 4 The PICs provide guidance for problem isolation by using.
  - a Intermittent problem determination
  - b POST
  - c Advanced diagnostics
  - d All the above
  - e b and c above
- 5 (True/False) Service aids for the IBM PC Convertible consists of two wrap adapters for the Serial/Parallel adapter option.
- 6 (True/False) The business executive does not need to be concerned about the environment when transporting the system into and out of drastically varying temperatures.

## Study Question Answers:

1. POST
2. True
3. c, e, d, a, b
4. d
5. True
6. False. The business executive or any other user should be very much aware of drastically varying temperatures. Intermittent system problems may result if the environment is not taken into consideration.



# Session 4: Technical Support and Incident Reporting

This session will take approximately 0.2 hour to complete

## Introduction

In this session you will learn who to contact for technical support and how incidents are reported.

The intent of this session is to make you aware of the proper procedures to follow when an intermittent or No Trouble Found problem needs to be resolved. You also need to know how to report your service calls through the DCS/PT, PDT or the QSAR document.

## Objectives

Upon completion of this session, using supporting documentation, you should be able to:

1. Use the Technical Support Structure to resolve an intermittent or No Trouble Found problem in a quick and timely manner.
2. Use the DCS/PT, PDT or the QSAR to send key information to the QSAR/P system.

## Objective 1 - Technical Support Structure

Use the Technical Support Structure to resolve an intermittent or No Trouble Found problem in a quick and timely manner.

## Highlights

- Support Class 1
- Support Classes 2 and 3

## Activity

### Support Class 1

The PC Convertible is Class 1 after it is announced.

Most hardware problems will be resolved by using the HMS diagnostic package. But, as you know, there are times when the diagnostics won't find the failure and you will need assistance.

Initially, (at Class 1 time) if you have an intermittent or No Trouble Found problem, Austin Service Business Product Planning (SBPP) will be your focal point for technical assistance. To reach the SBPP, call the current toll-free 800 number that is used for PC assistance.

Other resources for technical support are the branch office and the S/ECs.

## **Support Classes 2 and 3**

When the 5140 is at Support Classes 2 and 3, the region/branch office PC specialist will be the focal point for assistance.

### **Objective 2 - Incident Parts Reporting**

Use the DCS/PT, PDT or the QSAR to send key information to the QSAR/P system.

### **Highlights**

- Normal Reporting
- Special Reporting

### **Activity**

#### **Normal Reporting**

The PC Convertible is tracked within the Quality Service Activity Reporting/Process (QSAR/P) system. Use your Digital Communications System/Portable Terminal (DCS/PT or Portable Data Terminal) or NSD paper QSAR document (Z229-0459) to input service data into QSAR/P.

Machines sold through dealers do not show in the QSAR/P system unless the customer utilizes IBM NSD for warranty service. To receive warranty service, the customer must show proof of purchase or the machine must be in the master product inventory (MPI) file.

There are no unique service or activity codes for the 5140. Initially, exception call reporting will be in effect. Exception call reporting is a method of tracking comments from the field. You will be asked one or two questions at the time you input your service call data.

#### **Special Reporting**

There is no special reporting for the IBM PC Convertible.



## Study Questions

1. Which of the following should be used for technical support only at Class 1 time? (If more than one answer applies, separate letters with a comma.)  
  
☐ a. Branch Office  
☐ b. Austin Service Business Product Planning (SBPP)  
☐ c. 800 telephone number for PC Assistance  
☐ d. Diagnostics  
☐ e. Region
2. (True/False) The QSAR/P system will accept service data from the QSAR document, and the DCS/PT, but not the PDT.

## Study Question Answers:

1. b, c
2. False. The PDT can send service data to the QSAR/P system, along with the DCS/PT and the QSAR document.

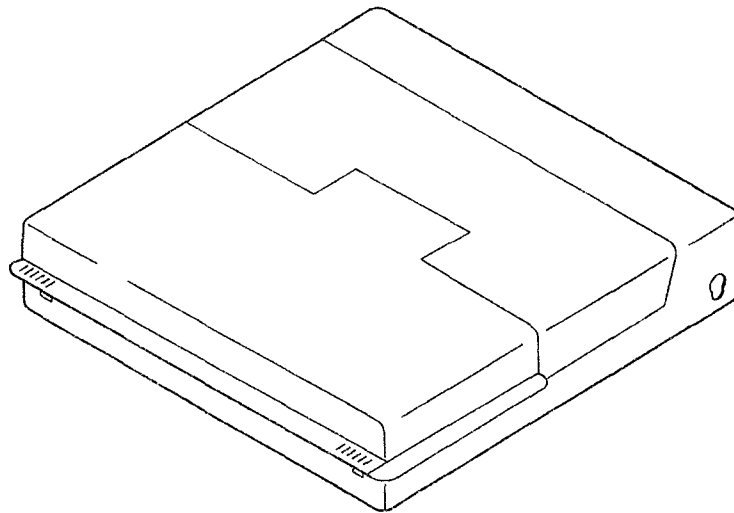
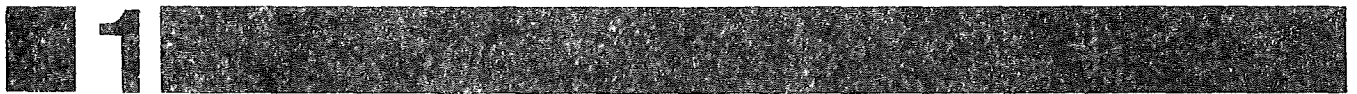
You have completed course 77479 Go to the Student Opinion Questionnaire section and complete the Data Collection Sheet and the Student Quiz.

# Appendix A. Installation Instructions

The set-up instructions are included with the IBM PC Convertible system. The installation steps are as follows.

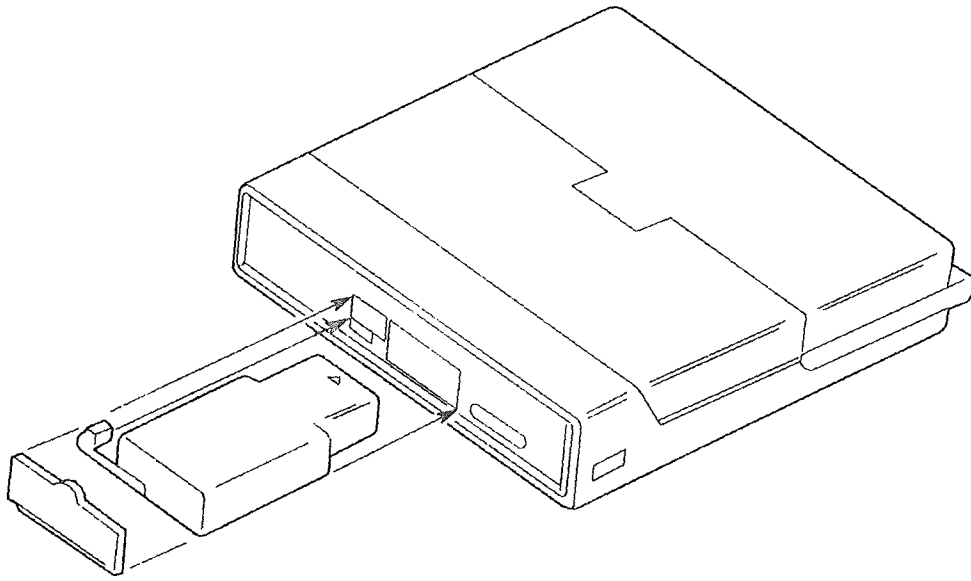
- 1 Show a picture of the PC Convertible
- 2 Install the battery pack
- 3-4 Open the top cover
- 5 Remove cardboard diskette from left diskette drive
- 6 Insert the Start-up diskette
- 7-8 Install the AC adapter to charge the battery pack and power the system
- 9 Press F1 to start a program called "Exploring" (It is an introduction to the system.)

These instructions do not have any words because the pictures speak for themselves. Each picture does have a number in the upper left-hand corner for reference. If any special features are to be installed, there are separate set-up instructions included with them.



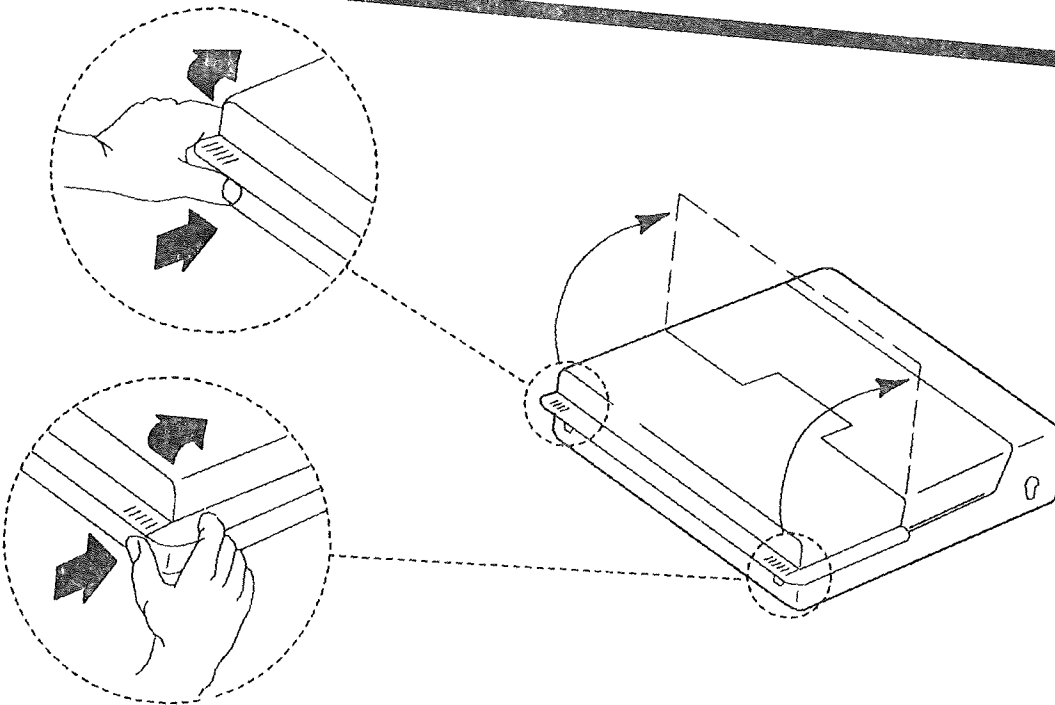
ATL00095

**2**



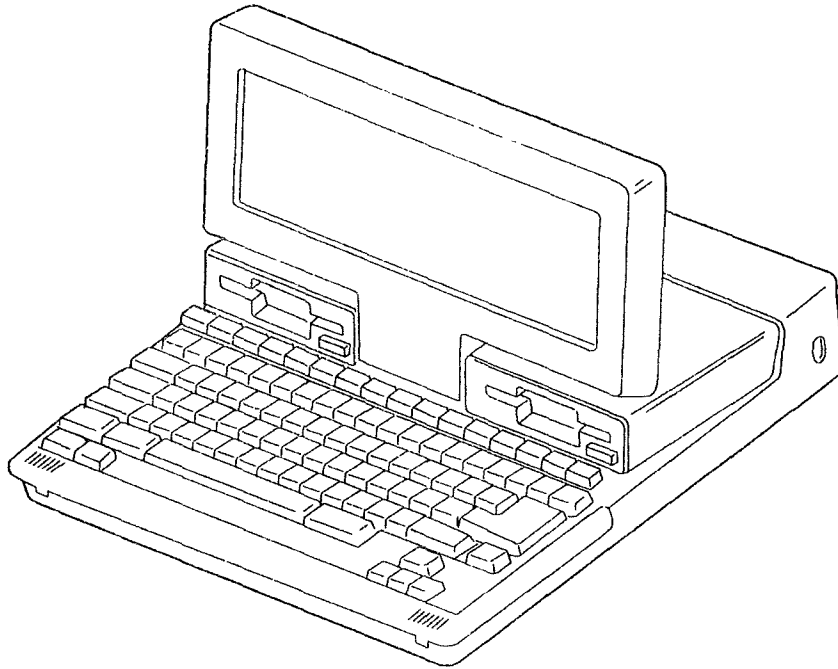
**3**

ATL00096



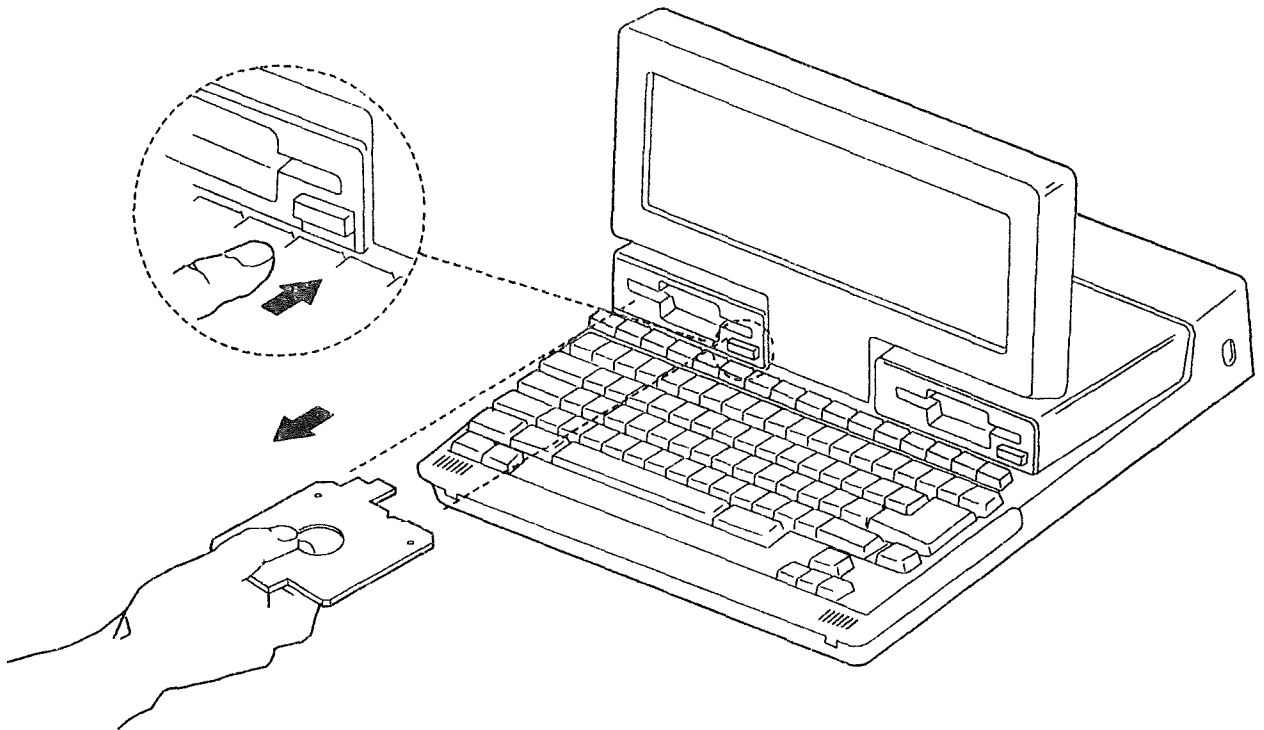
ATL00097

**4.**



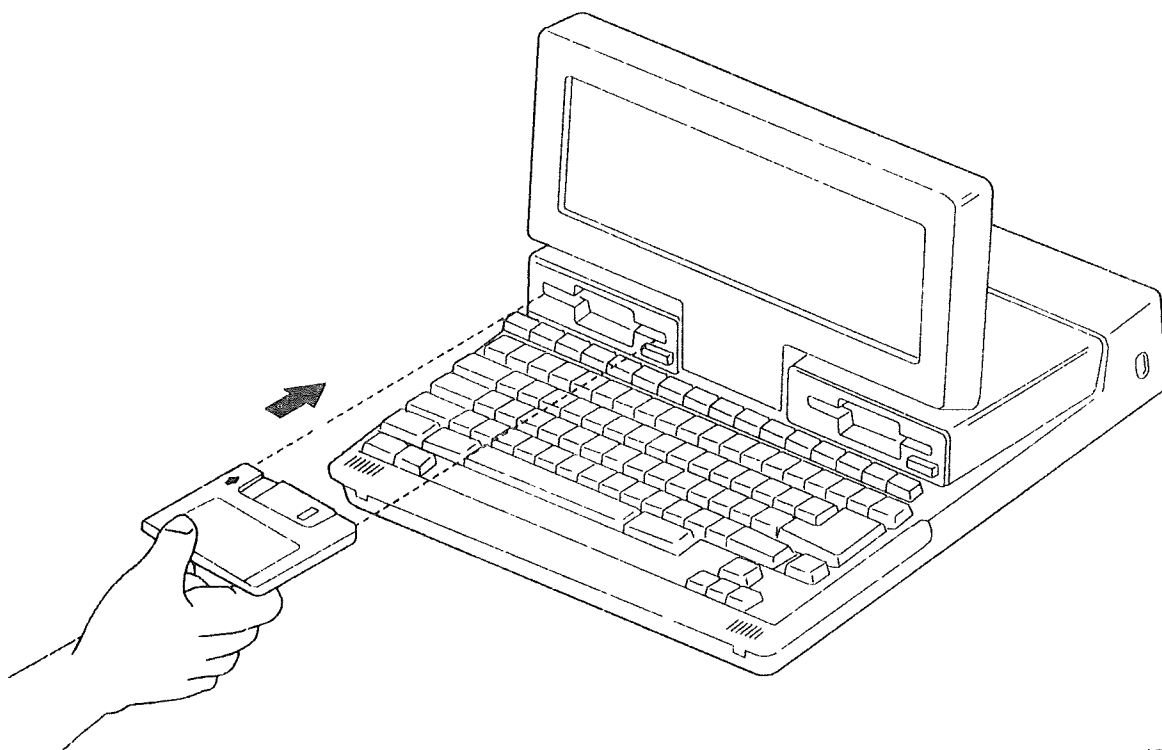
ATL00098

**5.**



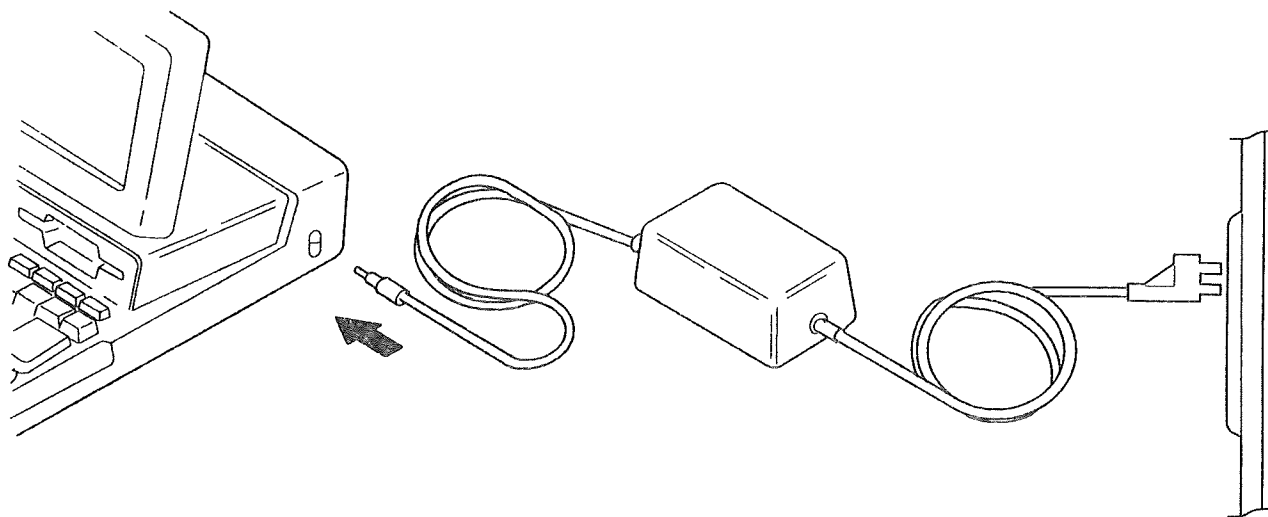
ATL00099

6



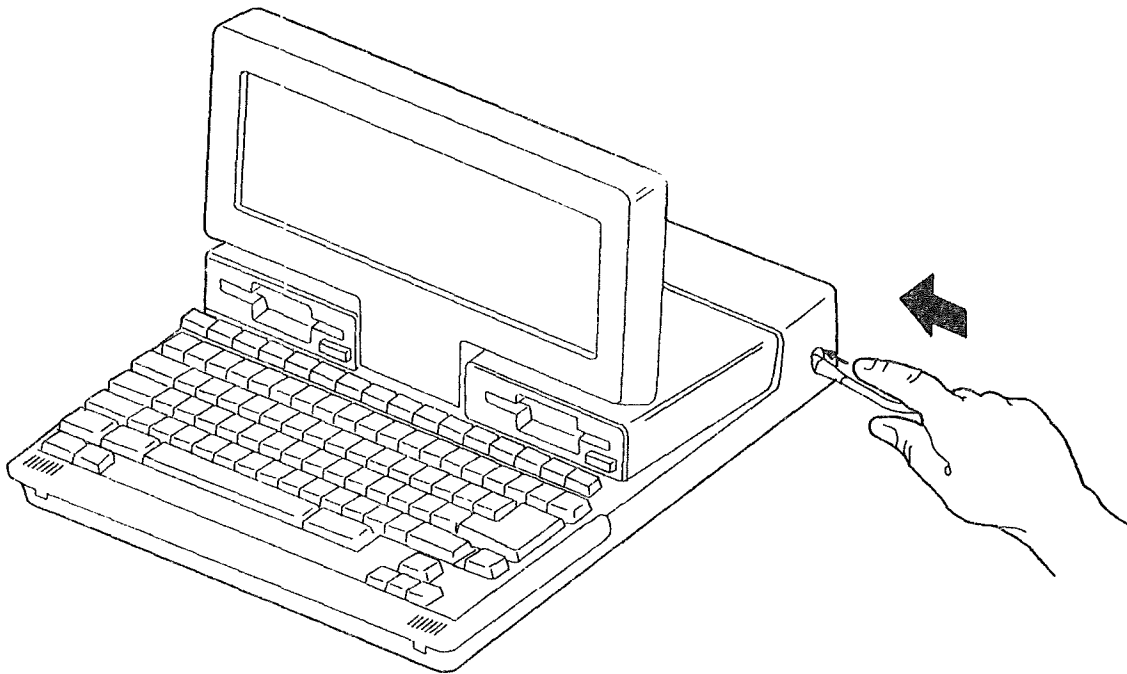
ATL00100

7



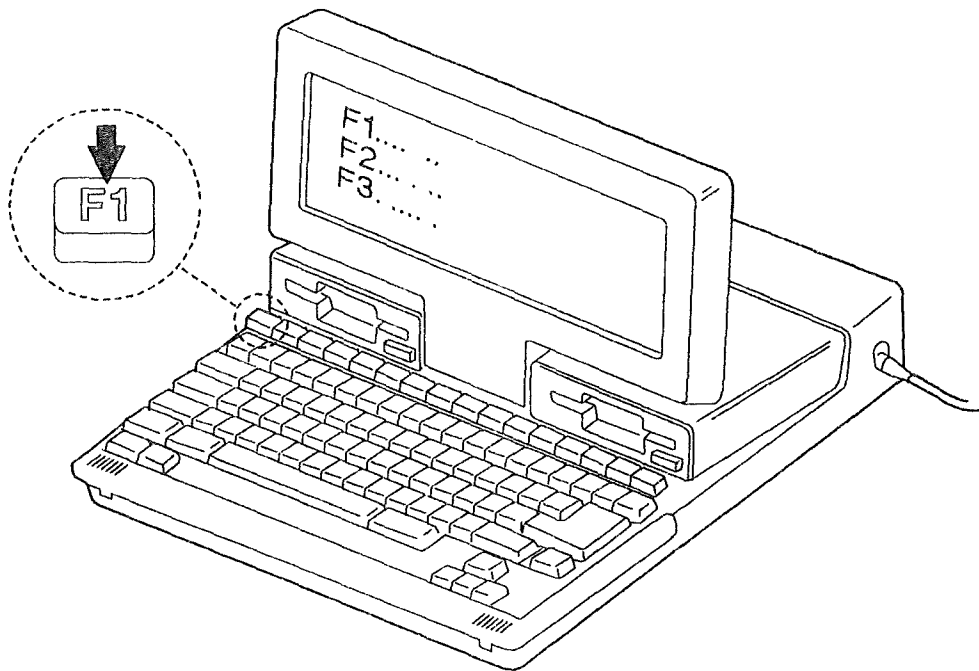
ATL00101

8



ATL00102

9



ATL00103

# Student Opinion Questionnaire

Your study of this course is now complete. Please rate the effectiveness of training provided by this course.

(Select A, B, C, D, or E.)

- A Very Good
- B. Good
- C. So-So
- D. Poor
- E. Very Poor

Record your selection in Box 0 of AREA 1 on the FIS Data Collection Sheet

Considering only this course, what is your opinion of each item below?

(Select G, S, or P for each item.)

G = Good                      S = So-So                      P = Poor

- 1 Procedures and directions
2. Structure and sequence
3. Material presentation
4. Subject coverage
5. Study and/or self-evaluation questions.

Record your selections in boxes 1 through 5 of AREA 1 on the FIS Data Collection Sheet.

If the Data Collection Sheet, ZR31-1007, is missing from this student guide, contact your branch office education monitor.



STUDENT NAME \_\_\_\_\_ STUDENT SERIAL \_\_\_\_\_ COURSE NUMBER \_\_\_\_\_

**AREA 1- STUDENT OPINION RESPONSES**☐

0

☐

1

☐

2

☐

3

☐

4

☐

5

☐

6

☐

7

☐

8

☐

9

☐

10

**AREA 2- ANSWERS TO COURSE QUIZ (MAXIMUM 20 CHARACTERS EACH)**

1.

2

3

4

5

6

7

8

9

10

11

12

13.

14

15

16

17

18

19

20

21.

22

23

24

25

26

27

28.

29

30

**AREA 3- TOTAL STUDY TIME FOR THIS COURSE TO DATE**☐☐☐

(FORMAT = HH T)

**AREA 4- COMMENTS TO COURSE AUTHOR (USE OTHER SIDE OF THIS FORM)**

FIS DATA COLLECTION SHEET

ZR31-1007-0

LEX60471

Fis Data Collection Sheet

AREA 4 - COMMENTS TO COURSE AUTHOR (USE ADDITIONAL PAPER AS REQUIRED)														

LEX60470

# IBM PC Convertible - Student Quiz (Course 77479)

Directions.

- Time required - The quiz requires approximately 0.5 hours to complete.
- Material - All available documentation may be used during the quiz.
- Answer sheet - Use the Data Collection Sheet provided with this course to record your answers. Remove the Data Collection Sheet from this training manual and enter your name, serial number, and course number. Then fill in the following information:

## AREA 1 - STUDENT OPINION RESPONSES

Enter your answers from the Student Opinion Questionnaire in AREA 1 of the Data Collection sheet.

## AREA 2 - ANSWERS TO COURSE QUIZ

Write your quiz answers in Area 2 of the Data Collection Sheet. There is only one correct answer for each question.

## AREA 3 - TOTAL STUDY TIME

Following the quiz, write the total study time for the course in AREA 3 of the Data Collection Sheet.

## AREA 4 COMMENTS TO COURSE AUTHOR

A comments area is provided in AREA 4, on the back of the Data Collection Sheet. Enter your comments on the course and/or quiz in this area.

When you have completed the quiz, give the Data Collection Sheet to your branch office education administrator. The administrator will enter the Data Collection Sheet information into the system, via the FIS terminal. The system will respond with the quiz results, and your completion certificate. The administrator will then return this data to you.

# Student Quiz

1 Which list of FRUs are the standard features for the PC Convertible?

- a Processor, RAM, battery pack, monochrome display, AC adapter, two 3.5" diskette drives, keyboard, power supply card, and the I/O channel interface connector
- b Battery pack, battery charger, power supply card, keyboard, ROM, RAM, LCD, two 3.5" diskette drives, and the I/O channel interface connector
- c Processor, battery pack, ROM, keyboard, RAM, two 3.5" diskette drives, LCD, AC adapter, I/O channel interface connector, and automobile power adapter
- d Keyboard, power supply card, AC adapter, battery pack, ROM, RAM, I/O channel interface connector, two 3.5" diskette drives, processor, and an LCD

For questions 2, 3, and 4 match each Optional Feature with the description below.

- a Serial/Parallel adapter
  - b CRT Display adapter
  - c Automobile power adapter
- 2 \_\_\_\_ This adapter provides the interface required to attach compatible direct drive and composite monitors to the 5140 system unit.
- 3 \_\_\_\_ This adapter attaches to the back of the system unit, system printer, or another optional feature. It has two functions: to communicate via an RS232C interface, or attach to any device or application that matches its input/output capabilities.
- 4 \_\_\_\_ This adapter provides power to the system unit and battery when attached to a cigarette lighter outlet.
- 5 \_\_\_\_ (True/False) The *Guide to Operations* manual is used by the customer to answer questions about the hardware or software, and to help them to solve operational or system failures.

For questions 6 through 10 put the following FRUs into one of two categories.

- a Externally attached
  - b Internally installed
- 6 \_\_\_\_ AC adapter
- 7 \_\_\_\_ Serial/Parallel adapter
- 8 \_\_\_\_ CRT Display adapter
- 9 \_\_\_\_ Modem
- 10 \_\_\_\_ RAM
- 11 The \_\_\_\_ is used as a guide to removing and replacing defective FRUs.

- 12 (True/False) The primary warranty period for the PC Convertible is one year and is Customer Carry-in Repair (CCR) service. The customer may optionally purchase IBM On-site Repair (IOR) to enhance the warranty service already provided.
- 13 Put the following Customer Problem Analysis and Repair (CPAR) strategy in the proper sequence.
- \_\_\_ Determine defective customer replaceable unit (CRU)
  - \_\_\_ Have CRU repaired or replaced
  - \_\_\_ Connect good CRU
- a 2, 3, 1  
b 1, 3, 2  
c 1, 2, 3
- 14 (True/False) Before attempting to run the Diagnostic Tests, POST should be run.
- 15 (True/False) The Start-up diskette and a formatted scratch diskette are needed to run the diagnostic tests.
- 16 (True/False) The Advanced Diagnostics can be run alone or in conjunction with the PICs.
- 17 The PICs provide guidance for problem isolation by using
- a Intermittent Problem determination
  - b POST
  - c Advanced Diagnostics
  - d All the above
  - e b and c above
- 18 (True/False) The business executive does not need to be concerned about the environment when transporting the system into and out of drastically varying temperatures.
- 19 Which of the following should be used for technical support only at Class 1 time? (If more than one letter applies, separate with a comma.)
- \_\_\_ a 800 telephone number for PC Assistance
  - \_\_\_ b Branch Office
  - \_\_\_ c Diagnostics
  - \_\_\_ d Austin Service Business Product Planning
  - \_\_\_ e Region
- 20 The \_\_\_\_ system will accept data from the QSAR document, the DCS/PT, and from the PDT.



ZR28-0616-0  
Course 77479  
Printed in U S A



ZR28-0616-00

